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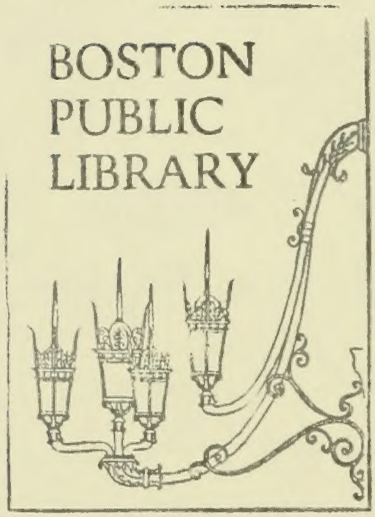

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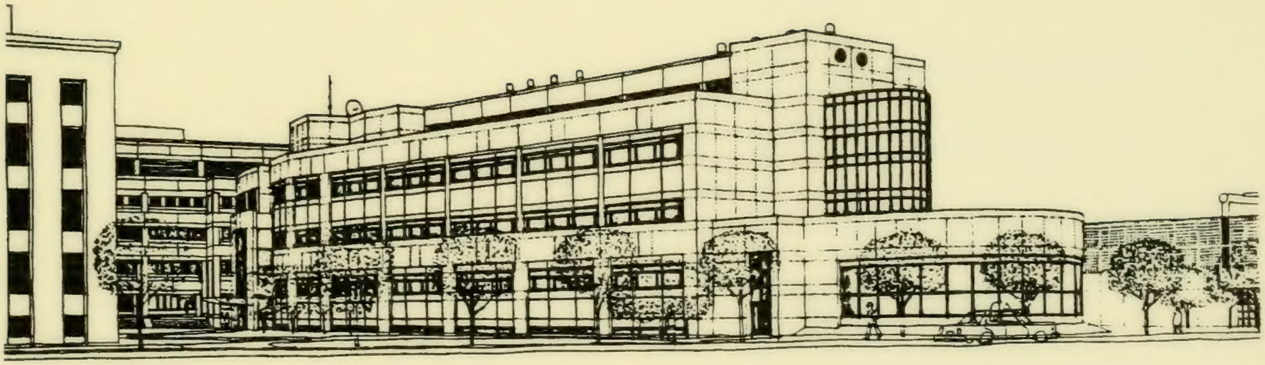
DRAFT PROJECT IMPACT REPORT

Submitted to Boston Redevelopment Authority



NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

3 May 1993

GW 96-1445

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NORTHEASTERN UNIVERSITY ENGINEERING SCIENCE CENTER PROJEC

Draft Project Impact Report

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1. GENERAL INFORMATION

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1. GENERAL INFORMATION

a. General Description of Project

Northeastern University proposes to construct a new 95,000 ± square foot facility to be known as the Engineering Science Center (the "Project") on University-owned property located adjacent to the Snell Learning Resource Center on Northeastern's campus. The Engineering Science Center will have a footprint of approximately 24,000 square feet. Building height is expected to be approximately 60 feet above grade plus an additional 15 feet for a mechanical penthouse. A basement floor (partially below grade) and three floors above grade will be used for program space of approximately 59,000 net assignable square feet.

The Engineering Science Center site is bounded by the Ruggles Street transit station on the south, Northeastern's Snell Learning Resource Center on the east, Forsyth Street on the west, and on the north by the southerly edge of a proposed landscaped mall of varying width which will separate the proposed building from the existing Snell Engineering Center and Dana Research Center to the north. The placement of the building will be consistent with the University master plan by acknowledging the public and academic edges, responding to Forsyth Street and Ruggles Street as a significant gateway into the campus, and having a building envelope that is harmonious with its context in scale, material and color.

The new Engineering Science Center will primarily function as a research facility. It will provide the opportunity for consolidation and expansion of current research activities, as well as accommodating potential new research activities. Currently, various related research activities are dispersed on Northeastern's campus; the Project will allow researchers, such as material scientists, to work in adjacent facilities. Expensive equipment will be located in joint instrumentation complexes and shared by a number of investigators. Enhanced laboratories and access to expanded facilities will strengthen Northeastern's ability to complete research projects, encourage faculty to compete for additional projects and assist in the recruitment of new faculty. The Engineering Science Center will be used to create focal points for interdisciplinary research in selected areas of current or future importance. The benefits of collaboration resulting from bringing appropriate groups into close proximity will be a primary consideration in making space assignments. The planning concept for the Engineering Science Center is predicated on a modular system that will be capable of change with a minimum of disruption to the building's infrastructure and ongoing research. The building will also include space for group presentations and other research support space.

The new Engineering Science Center will be the most prominent structure visible as one enters the campus from the Ruggles Street MBTA Station. This facility will also be the first new major structure to form an edge of the proposed pedestrian mall,

which is part of the Northeastern campus master plan. In addition, the new Engineering Science Center could provide an extension to the existing underground pedestrian tunnel system currently terminating at the west end of the Snell Engineering Center. This extensive system on campus provides convenient access to most central University buildings during inclement weather.

b. Project Identification

(1) Development Team:

Developer:	Northeastern University 360 Huntington Avenue Boston, Massachusetts Designated Contact: Thomas J. Keady, Jr. Director of Government Relations and Community Affairs Jeanne Levesque, Associate Director of City Relations Phone: (617) 437-5805
Architects:	Cannon 148 State Street Boston, Massachusetts 02109 Designated Contact: Garrick Niemiec, Chung Lee
Legal Counsel:	Palmer & Dodge One Beacon Street Boston, Massachusetts 02108 Designated Contact: David R. Rodgers Phone: (617) 573-0362
Mechanical and Electrical Engineering:	Cosentini Associates 44 Brattle Street Cambridge, Massachusetts 02138 Designated Contact: Richard Leber
Geotechnical Engineers:	Haley & Aldrich, Inc. 58 Charles Street Cambridge, Massachusetts 02141 Designated Contact: Mark Haley

Environmental (Air Quality) Consultants:	Life Energy Associates 20 Darton Street Concord, Massachusetts 01742 Designated Contact: David Bearg
Civil Engineering:	Vanasse Hangen Brustlin, Inc. 101 Walnut Street Watertown, Massachusetts 02172 Designated Contact: Brian Bakis

(2) Legal Information

(1) To the Developer's best knowledge, there are no legal judgments or actions pending concerning the Project.

(2) The Project site is owned by Northeastern University and located within the University's central campus area.

(3) The Project site is adjacent to the Massachusetts Bay Transportation Authority ("MBTA") Ruggles Street Station to the south and Forsyth Street, a public street, to the west. The MBTA currently holds an easement in a portion of the site ten feet in width running along the southerly and westerly boundaries of the site, for maintenance of the MBTA's facilities.

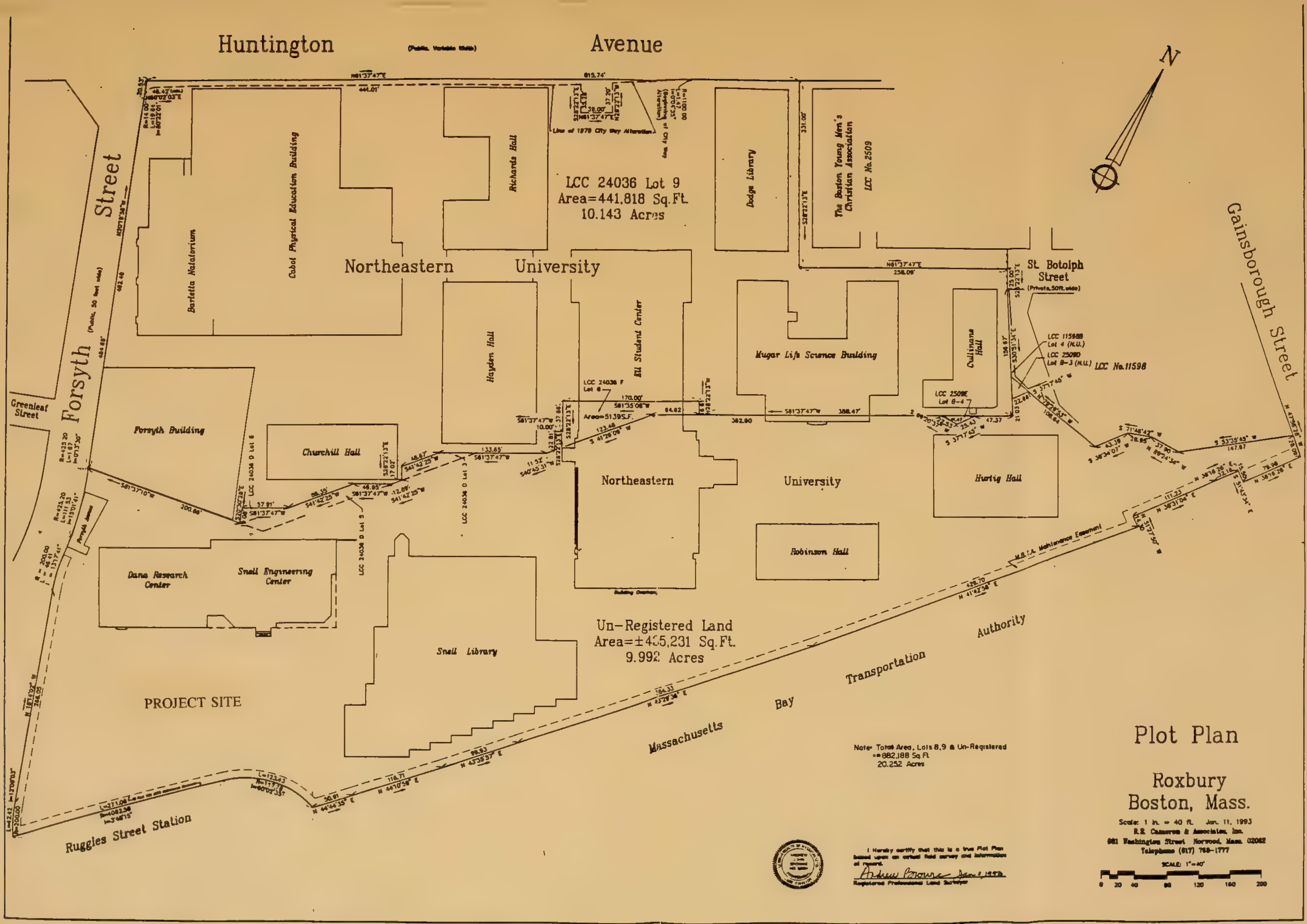
c. Financial Information

A portion of the Project cost will be financed by federal grants. The balance of the cost of the Project will be financed through issuance of tax exempt bonds, other institutional financing, fundraising from private donors, or a combination of such sources. The Project cost is currently estimated at $30,000,000, as shown on the Project Budget set forth below.

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER BUDGET

July, 1992

CONSTRUCTION AND EQUIPMENT:	
Building, Site, Improvements, Permitting	23,934,000
Laboratory Equipment	500,000
Non-Generic Laboratories	500,000
Furnishings	1,250,000
Technology Transfer Center	766,000
Tunnel	350,000
Total Construction and Equipment	27,300,000
FEES:	
Architecture/Engineering Fees	1,950,000
Programming	150,000
Geotechnical, Acoustic, Vibration & Environmental Consultants	525,000
Moving	75,000
Total Fees	2,700,000
PROJECT TOTAL	30,000,000



Note: Total Area, Lots 8,9 & Un-Registered
=882,188 Sq. Ft.
20.252 Acres

I Hereby certify that this is a true Plot Plan based upon an actual field survey and information of record.

Andrew Browne Jan. 1993
Registered Professional Land Surveyor

Plot Plan

Roxbury
Boston, Mass.

Scale: 1 in. = 40 ft. Jan. 11, 1993
R.E. Cameron & Associates, Inc.
681 Washington Street Norwood, Mass. 02062
Telephone (617) 769-1777

SCALE: 1"=40'
0 20 40 80 120 160 200

e. Project Benefits

(1) Northeastern will meet with the City of Boston Assessor's Office to discuss the City's request for a payment in lieu of taxes with respect to the proposed Engineering Science Center.

(2) Employment Benefits

(1) An estimated 100 direct construction jobs (total payroll approximately $9 million), plus indirect jobs (typically estimated to exceed the number of direct construction jobs), will be generated by the Project.

(2) The number of persons employed at the Center upon completion of the Project will vary depending on the research projects in progress. At peak, up to 150 people will work in the new Engineering Science Center. Of these employees, some new positions will be created, while a majority of the positions will be transfers from within the University community. The University estimates that six new employees will be located at the Center.

(3) By modernizing and improving its engineering and science laboratories and related facilities, the Project will help Northeastern to attract well-qualified faculty, graduate students and other researchers to the Northeastern community, causing direct and indirect employment and other economic benefits for the city of Boston.

(4) Boston Residents Construction Employment Plan. Northeastern intends to participate in the Boston Residents Construction Employment Program.

(3) Educational Resources.

Established in 1898, Northeastern University is one of the largest private universities in the United States. Currently Northeastern's College of Engineering ranks among the largest private colleges in undergraduate engineering enrollment, and in the top ten in bachelors degrees awarded and Master of Science degrees granted. Northeastern has the largest minority enrollment of any college or university in the New England region, and more minority engineering students than any other school. Northeastern contributes more graduates to high technology companies in the East than any other college or university in the area. Northeastern's engineering programs include Electrical Engineering (with Computer Engineering and Power Systems options); Chemical Engineering; Civil Engineering (with an Environmental Engineering option); Industrial Engineering; Mechanical Engineering; and the

General Engineering program. The College of Engineering is committed to supporting sophisticated research efforts by its faculty and students. This commitment includes the construction of the proposed Engineering Science Center. A solid research and educational base is necessary for the continuing viability and further development of high technology industries, and is therefor of critical importance to the city of Boston and the region. The proposed Engineering Science Center Project is an essential part of Northeastern's plan to further enhance its strengths in engineering and related fields, as well as a key component of Northeastern's long range plan to assist in the development of a technology center in the Southwest Corridor area. The Project will represent a clear benefit to the city of Boston, in its own right and as a part of Northeastern's continuing commitment to development of research and educational programs that support engineering and high tech industry.

(4) Other Public Benefits

In addition to the educational resources it provides, Northeastern is a major employer in the Boston area, and currently provides a multitude of benefits to the communities surrounding the University and the city at large, including, for example:

Engineering Programs.

- Northeastern University's Progress in Minority Engineering (NUPRIME)

  Northeastern University's Progress in Minority Engineers Program (NUPRIME) was developed in 1974 as part of a nationwide effort to increase the number of qualified African-American, Hispanic, and Native American engineers. NUPRIME was established to improve the chances of these students succeeding in engineering both before they enter college and after matriculating at Northeastern. NUPRIME staff recruit qualified or qualifiable minority students to Northeastern's engineering programs. NUPRIME offers support services to help these students succeed and graduate as professional engineers. In addition, individual tutors are provided to help students succeed. NUPRIME provides financial support and advice to program participants. Most packages include a combination of grants, loans, and work-study jobs.

- Pre-NUPRIME

  In 1978, Northeastern University, the Sippican Ocean Corporation, General Electric (replaced by GTE in 1985), and Tabor Academy agreed to help public high schools in eastern Massachusetts prepare

minority students to be successful engineering students in college through the Pre-NUPRIME program. The objectives of the program are to broaden and deepen students' pre-calculus mathematics and physics skills, to diagnose and correct deficiencies in study skills, and to introduce students to engineering career possibilities and their requirements. Students are admitted on the recommendation of teachers and counselors. Those who are accepted must indicate both an interest in engineering as a career and an eagerness to do the work.

- Massachusetts Pre-Engineering Program (MassPEP)

  Dean Thomas Hulbert has served on the Board of Directors of the Massachusetts Pre-Engineering Program (MassPEP) for the past nine years. The program works with Boston as well as Cambridge students from middle through high school to prepare them for careers in science and engineering. Professor of Civil Engineering Reginald Amory also serves on the board. Northeastern University contributes financial assistance to this program.

- Engineering Information Workshops for High School Students

  For the past two years, Northeastern has sponsored engineering information workshops for high school students. Small group discussions are held during the sessions with resource people from admissions, financial aid, cooperative education, and student housing. In addition, Northeastern faculty meet with individual students referred by the Office of Admissions.

- High School Guidance Counselor and Teacher College of Engineering Programs

  The semi-annual High School Guidance Counselor and Teacher program has been offered for the past three years. Lectures and discussions focus on current programs in engineering and issues concerning engineering education in the 1990s. Counselors and teachers are given tours of engineering laboratories.

Scholarship Programs.

- Boston Public Schools Scholarship Program

  Each year the University provides sixty first-year, full tuition grants for students graduating from Boston's public high schools. Candidates are awarded these grants based on their high schools records, College

Board scores, leadership potential, and other factors. The committee attempts to include students from all of the neighborhoods and each high school.

- City of Boston Employees Graduate Scholarship Program

  Northeastern sponsors a scholarship program for city of Boston employees for study at the graduate level. Each quarter, ten two-course scholarships are available to city of Boston employees who are enrolled in any graduate program at Northeastern University. The students must be accepted into the program before applying for the scholarship. The estimated cost of this program is $64,000 per year.

- Boston Housing Authority Scholarship Program

  The Boston Housing Authority Scholarship Program, begun in 1983, offers one hundred full-tuition scholarships each year to incoming full-time first-year students and one hundred courses per quarter to part-time students.

- Tobin School "Ticket to Success" Scholarship Program

  Northeastern University adopted the sixth grade class at the Maurice Tobin School in Mission Hill in 1991 and offered 22 students full-tuition scholarships provided they meet Northeastern entrance requirements. The class represents the first installment in a 10 year, $5 million program, which will grow to include 100 students.

- City Year Scholarship Program

  Northeastern University has formed a partnership with City Year, a Boston-based Urban Peace Corps, to provide scholarships to qualified students in the program. Under the plan, all graduates of City Year who gain admission to Northeastern will receive a $2,500 tuition waiver.

- Allston-Brighton Scholarship

  A one year, full tuition scholarship is awarded to a resident of Allston-Brighton who has strong ties to the community and an exemplary record of community service. Northeastern University freshmen and upper-class students are eligible for the scholarship.

Community and City Programs.

- Fenway Community Health Center contribution ($25,000 per year for a 20 year period). This funding helps the Center, which has pioneered compassionate health care for people suffering from AIDS, meet its daily operating expenses.

- Mayor's Youth Leadership Corps (including $15,000 per year contribution).

  Co-founded by Northeastern University, the City of Boston and the Boston Bar Association, this program offers academic, civic and cultural opportunities to teenagers selected from public, private and parochial high schools in Boston. The program emphasizes the importance of participation, responsibility, discipline and self-respect and promotes leadership in youth who may serve their communities as adults.

- Community Liaison Position ($26,000 per year).

- Boston Police Department Walking Patrol ($8,000 per academic year). Northeastern University campus police and the Boston Police Department have formed a partnership in which a "team" of officers walk the Fenway neighborhood on Friday and Saturday evenings.

- Little Brothers Friends of the Elderly ($2,500 donation per year). Northeastern University assists the Little Brothers at Thanksgiving, Christmas and Easter by making its kitchens, food service personnel, staff, faculty and students available to prepare and deliver special holiday meals to elderly shut-ins throughout the City.

- Conducted Boston Public Schools Study. Northeastern University assisted Mayor Flynn and the Boston School Committee by conducting an in-depth assessment of the Boston Public School system and issued its findings and recommendations in July of 1991.

- Overnight Camp for Neighborhood Children. Each summer Northeastern University sponsors approximately 200 youths, ages seven to fifteen from Roxbury, Mission Hill, the Fenway and the South End, to participate in a two week overnight camping experience. The University works closely with area community agencies in recruiting youngsters for the camp.

(5) Improved Quality of Campus Environment.

A significant portion of the Project cost is budgeted for landscaping improvements in the vicinity of the Project site and in the pedestrian mall to be created between the Project site and the existing Snell Engineering Center and Dana Research Center. This work is part of Northeastern's long-term plan to further articulate its campus and improve the quality of the pedestrian environment in and around its campus. The Project is a particularly important component of that plan, because the Project site and the areas proposed for landscape improvements are in close proximity to the MBTA Ruggles Street Station, and because the proposed new mall will be a primary pedestrian and visual axis for the campus. Improving the pedestrian environment for persons coming to the Northeastern/Museum/ Mission Hill area via public transportation is an important objective for both Northeastern and the city of Boston.

(6) Development Impact Project (Linkage) Requirements

Development Impact Project contributions are not required for the Project, because the gross floor area of the proposed building will be less than 100,000 square feet.

f. Regulatory Controls and Permits

(1) Zoning Relief

The Project site is in an H-3 Zoning District, the Institutional Overlay District and the Restricted Parking Overlay District. The Project will require zoning relief as follows:

(i) Conditional Use Permits; the Project will require conditional use permits for university, laboratory and accessory uses (Boston Zoning Code Use Items No. 16A, 24 and 79).

(ii) Subject to finalization of the design of the Engineering Science Center as it affects the size, shape and placement of the proposed building, Northeastern anticipates that variances will be required from the provisions of the Boston Zoning Code governing (a) rear yard depth, and (b) setback of parapet-rear.

(2) Other Permits and Approvals

Permits, approvals or other actions may be required from the following public agencies:

Agency	Permit or Action
Massachusetts Office of Environmental Affairs/MEPA Unit	Determination that no EIR is required (see below)
Massachusetts Historical Commission	Determination of no adverse effect
Massachusetts Water Resources Authority	Sewer use discharge permit
Massachusetts Department of Environmental Protection, Division of Water Pollution Control (with Boston Water and Sewer Commission)	Sewer extension/connection permit
Massachusetts Department of Environmental Protection, Division of Water Pollution Control	Cross-connection permit
Massachusetts Department of Environmental Protection, Division of Air Quality Control	Approval of fossil fuel utilization facilities (emergency generator); pre-construction notification
Executive Office of Transportation and Construction	Consent to construction on former railroad land
City of Boston Department of Public Works/Public Improvements Commission	Permits or easements for street or sidewalk alterations, encroachments or discontinuances, street occupancy, and curb-cuts

(3) Massachusetts Environmental Policy Act Review

Copies of the Environmental Notification Form for the Project filed with the MEPA Office of the Executive Office of Environmental Affairs, and of the Certificate of the Secretary of EOEA indicating that no Environmental Impact Report will be required for the Project, have previously been delivered to the Authority.

g. Community Review

The site of the Project is located in the heart of Northeastern's campus and is surrounded by University academic buildings, except that portion of the site which abuts the Massachusetts Bay Transportation Authority Southwest Corridor and Forsyth Street. The property on the other side of Forsyth Street is also part of Northeastern's campus. Accordingly, given the size and scope of the Project it is not anticipated that the Project will have any impact on the neighborhoods which adjoin Northeastern's campus, and there are no abutters or community groups which, in the opinion of the applicant, will be substantially affected by the proposed Project. However, Northeastern has contacted appropriate representatives from the Lower Roxbury, Mission Extension and Fenway neighborhoods, as well as the Parcel 18 Task Force, to facilitate review of the Project with the community. The Mayor's Office of Neighborhood Services has been and will continue to be involved in this process.

Abutters:
Massachusetts Bay Transportation Authority
Real Estate Management Division
10 Park Plaza
Boston, Massachusetts 02116

Community Groups:
Joint Committee
c/o Richard & Vicki Galler
Symphony United Neighbors
43 St. Stephen Street
Boston, Massachusetts 02115

Parcel 18+ Task Force, Inc.
P. O. Box 1048
Boston, Massachusetts 02118
Attn: Rev. Tony Bethel

Community Meetings Held:

February 13, 1992 - The Project was presented to representatives of the Joint Committee which consists of a number of community groups in the Fenway area, including:

- Fenway Civic Association
- Symphony Area Renaissance, Inc.
- Symphony United Neighbors
- Gainsborough Street Neighborhood Association

June 11, 1992 - The Project was presented to the Executive Committee of the Parcel 18+ Task Force. The Parcel 18+ Task Force serves as an umbrella group representing a number of community groups in the Roxbury area, including:

- Madison Park Development Corp.
- Roxbury Action Program
- Roxbury Community College
- Roxbury Neighborhood Council
- Shawmut Community Church
- United Neighbors of Lower Roxbury
- Whittier Street Neighborhood Health Center
- Alice Heywood Taylor Apartments
- Academy Homes I and II
- Whittier Street Neighborhood Association
- Wentworth Institute

Full community meetings will be scheduled in both the Fenway and Roxbury communities upon completion of the Draft Project Impact Report.

2. TRANSPORTATION

DRAFT PROJECT IMPACT REPORT
TRANSPORTATION SECTION

ENGINEERING SCIENCE CENTER
NORTHEASTERN UNIVERSITY
Boston, Massachusetts

Prepared for: Northeastern University
Boston, Massachusetts

Prepared by: Vanasse Hangen Brustlin, Inc.
Engineers, Planners, and Scientists
101 Walnut Street
P.O. Box 9151
Watertown, Massachusetts 02272

April 1993

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2	Vehicle-Trip Distribution
3	Peak Hour Traffic Volumes
4	Northeastern University Engineering Science Center - Pedestrian and Service Vehicle Access

INTRODUCTION

The purpose of this section of the Draft Project Impact Report (DPIR) is to address transportation and parking issues associated with the development of the proposed Engineering Science Center (ESC) at Northeastern University. This section was written in response to the scoping determination by the Boston Redevelopment Authority (BRA) and the Boston Transportation Department (BTD) dated May 22, 1992. In response to this scope, base transportation conditions, projected project impacts and future transportation conditions were evaluated. In addition, the project's short-term (construction period) impacts and Northeastern University's proposed mitigation plan are presented.

The proposed Engineering Science Center (ESC) consists of a four level building with approximately 95,000 square feet gross floor area to be used as research laboratories for Northeastern University engineering and science research programs and supporting offices. The specific research programs to be located in the ESC have not been finally determined. The project will include development of a landscaped pedestrian mall adjacent to the ESC building. The project will result in other significant benefits to the City of Boston and the Commonwealth including the enhancement of Northeastern's strengths in engineering and related fields and its substantial contributions to high technology companies in the region.

The site of the proposed building is a parcel of land currently owned by Northeastern on its main campus northeast of Forsyth Street. It is adjacent to the Ruggles MBTA Station, northwest of the MBTA Southwest Corridor right-of-way, southwest of Northeastern's Snell Learning Resource Center, and southeast of the Snell Engineering Center and Dana Research Center. The site currently contains a 156-space surface parking lot used by Northeastern faculty and staff.

BASE TRANSPORTATION CONDITIONS

Base traffic, parking, transit, and pedestrian conditions are described in this section. In response to the Boston Redevelopment Authority's (BRA) scoping determination, the traffic analysis addresses concerns at the intersection of Columbus Avenue and Melnea Cass Boulevard. The intersection was chosen by the Boston Transportation Department (BTD) for analysis because the most significant increase in traffic as a result of the ESC project is expected there. The parking system at Northeastern University and the parking supply on the site are also discussed in this section. The transit system serving the site is presented in addition to a description of the pedestrian environment on and adjacent to the site.

TRAFFIC

Base Traffic Volumes

Figure 1 presents Base traffic volumes at the intersection of Columbus Avenue and Melnea Cass Boulevard. Base traffic volumes are presented for the morning and evening peak hours. As directed by the BTD, these volumes are based on traffic counts conducted for the Parcel 18/Ruggles Center EIR. The counts were conducted in the fall of 1988 by Howard/Stein-Hudson Associates. Level-of-service analyses for the Base Condition were conducted using these traffic volumes.

Base Level-of-Service Analysis

This section presents the results of the level-of-service analysis for the intersections of Columbus Avenue and Melnea Cass Boulevard during the morning and evening peak hours. Before presenting the analysis results, a brief discussion of the analysis procedure is presented.

Signalized Intersection Level-of-Service Analysis Procedure. Levels of service for signalized intersections were calculated using the operational analysis methodology of the 1985 Highway Capacity Manual (HCM).[1] This method assesses the effects of signal type, timing, phasing, progression, vehicle mix, and geometrics on delay. Level-of-service designations are based solely on

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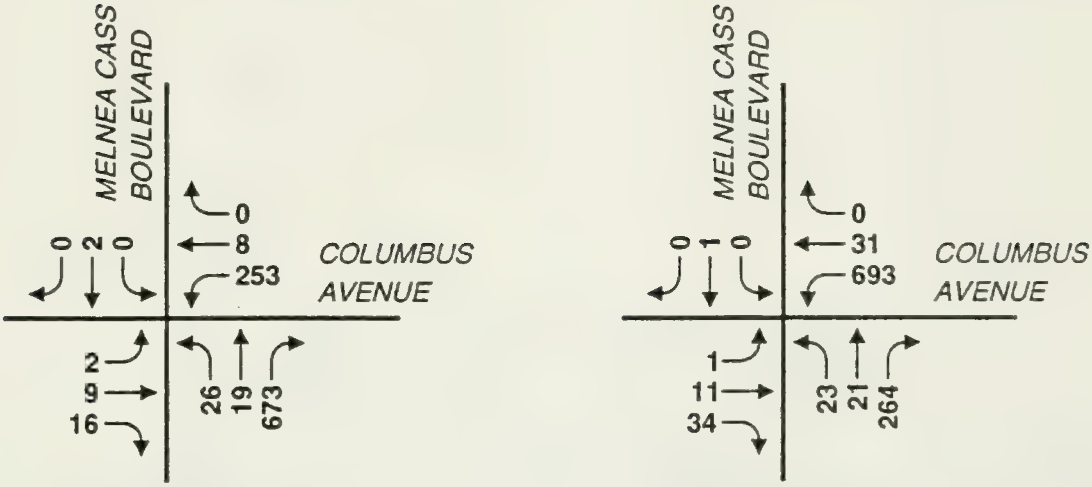
1/ Highway Capacity Manual, Special Report 209; Transportation Research Board, Washington, DC (1985).

BASE
CONDITIONS



AM PEAK HOUR

PM PEAK HOUR

Vanasse Hangen Brustlin, Inc.

Base Condition
Peak Hour Traffic Volumes

Figure 1

3138NET

the criterion of average stopped delay per vehicle, since delay is an imputed measure of driver discomfort, frustration, fuel consumption, and increased travel time. Table 1 summarizes the current standard relationship between level of service and delay. The tabulated delay criteria may be applied in assigning level-of-service designations to individual lane groups, intersection approaches, or to entire intersections. Delays and level of service are reported for entire intersections.

Table 1 **Level-of-service Criteria for Signalized Intersections**

Level of Service	Stopped Delay per Vehicle (seconds)
A	≤5.0
B	5.1 to 15.0
C	15.1 to 25.0
D	25.1 to 40.0
E	40.1 to 60.0
F	>60.0

Source: Highway Capacity Manual, Special Report 209; Transportation Research Board; Washington, DC (1985).

The volume-to-capacity (V/C) ratio is another measure used in the signalized intersection analysis. Although it is reported along with level of service in the intersection analysis results tables, calculated delays determine level of service and level of service cannot be directly related to intersection capacity. It is possible to have delays in the level-of-service F range without exceeding an intersection's capacity. This is possible if one or more of the following conditions exist:

- Long signal cycle lengths
- A particular traffic movement experiences a long red time
- Progressive movement for a particular lane group is poor

For the reasons stated above, both capacity and level of service must be carefully examined when analyzing a signalized intersection. The designation of an approach as operating at LOS F does not automatically imply that the entire intersection, approach, or lane group is overloaded, nor does a level of service in the A to E range automatically indicate that there is unused capacity available.

Level-of-Service Analysis Results. Level-of-service analyses were conducted for all conditions using a computer program (CINCH)[2] based on the 1985 Highway Capacity Manual. Table 2 presents the results of the level-of-service analysis for the intersection of Columbus Avenue and Melnea Cass Boulevard under the Base Condition during the morning and evening peak hours. The procedure and the parameters used in the analysis for this report closely follow

---

[2] The Capacity of Intersections: CTPS's HCM Software (CINCH); Boston: Central Transportation Planning Staff (1987).

that used in the Ruggles Center EIR for the Base Condition. As shown, the intersection operates at LOS A during both peak hours. Detailed level-of-service analysis is presented in the Appendix.

Table 2 **Base Condition Level-of-Service Analysis Results - Columbus Avenue and Melnea Cass Boulevard**

Morning Peak Hour			Evening Peak Hour		
V/C*	Delay**	LOS***	V/C	Delay	LOS
0.57	5	A	0.58	5	A

Source: Vanasse Hangen Brustlin, Inc.
* Volume-to-capacity ratio.
** Average stopped delay per vehicle in seconds.
*** Level of service.

PARKING

The existing University parking system and the characteristics of the Hayden Lot, the site of the proposed ESC building, are discussed in this section.

The majority of the parking spaces provided by Northeastern University are located in large parking lots in the southwest sector of the campus (along Ruggles and Parker Streets) and southeast of the Southwest Corridor along Columbus Avenue where, in addition to surface parking, a 995-car parking garage is available for University-related parking. Parking is also provided within the campus core in many of the courtyard spaces immediately adjacent to the academic, research and student housing facilities.

The parking supply at Northeastern University is well used throughout the day with 90 percent of the parking occupied by 9:00 AM each day. As expected, the lots located closest to the academic core are filled first and normally remain fully occupied for the longest period of the day. Since Northeastern University conducts a substantial number of evening classes, occupancy of parking spaces rises again in the early evening.

Currently, the proposed site for the ESC houses the 156-space surface parking facility known as Hayden Lot. This facility is used by Northeastern faculty and staff members on a first come/first serve basis. Because of its prime location with respect to the campus core, the Hayden Lot generally fills up early and remains full, with little turnover, until mid-to late afternoon when some day faculty and staff leave and evening faculty and staff arrive. To park in the lot, a valid faculty/staff decal must be displayed on the vehicle. The decal costs $135 per academic quarter or $225 per year. Northeastern University security personnel patrol its lots to ensure that all vehicles have valid parking decals. The Hayden Lot represents less than 4% of the total Northeastern University parking supply.

TRANSIT

The ESC project site and the Northeastern campus as a whole is very well served by public transportation. The site is adjacent to Ruggles Station which is served by the MBTA Orange Line, the Franklin, Needham, and Attleboro/Stoughton commuter rail lines, and thirteen local MBTA bus routes. The MBTA bus routes serving Ruggles Station include:

- Route 8: Ruggles-Columbia Point/UMass
- Route 15: Ruggles-Kane Square or Fields Corner
- Route 17: Ruggles (or JFK Station)-Fields Corner
- Route 19: Ruggles-Fields Corner
- Route 22: Ruggles-Ashmont via Talbot Avenue
- Route 23: Ruggles-Ashmont via Washington Street
- Route 28: Ruggles-Mattapan via Dudley Square
- Route 29: Ruggles-Mattapan via Jackson Square
- Route 42: Ruggles-Forest Hills
- Route 43: Ruggles-Park and Tremont Streets
- Route 44: Ruggles-Franklin Park Zoo via Seaver Street
- Route 45: Ruggles-Franklin Park Zoo via Blue Hill Avenue
- Route 47: Central Square, Cambridge-Andrew Station

All of the bus routes, except Route 47, terminate at Ruggles Station. On a daily basis, 990 buses come into the station, with about 140 of these providing service during the peak hour. Peak hour headways for the bus routes vary from 6 to 20 minutes. These bus routes are designed to provide feeder service to the Orange Line, and will provide direct service to the ESC site. Peak hour headways are five minutes for the Orange Line. Eleven (11) peak morning period and 19 peak evening period commuter trains stop at Ruggles Station between the three lines on weekdays.

The site is near the E branch of the Green Line and MBTA Bus Route 39 which both travel along Huntington Avenue. Peak hour headways are four minutes for the Route 39 bus and eight minutes for the E branch of the Green Line.

PEDESTRIANS

Open space at Northeastern University is at a premium due to its urban location. The existing open space system is based on a series of courtyard spaces linked by connecting paths between buildings. In general, a shortage of usable open space exists overall on campus, and landscape materials in many areas are limited to foundation plantings along buildings. In recent years, the University has begun to address this shortage of open space and has significantly increased its landscaping.

There is a high level of pedestrian activity in the vicinity of the site due to the location of Ruggles Station and the parking facilities south of the Southwest Corridor. Vehicle activity associated with the 156-space parking lot on the site creates the potential for conflicts between vehicles and pedestrians during peak hours.

FUTURE TRANSPORTATION CONDITIONS

Project impacts and projected future traffic, parking, transit, and pedestrian conditions are evaluated in this section of the DPIR. The traffic analysis addresses the intersection of Columbus Avenue and Melnea Cass Boulevard which was selected by the Boston Transportation Department. The intersection was chosen for analysis because the most significant increase in traffic is expected there as a result of the ESC project. In fact, a decrease in traffic volumes is expected at intersections adjacent to the site because existing parkers utilizing the 156-space parking facility on the site will be relocated to the 995-space garage and other surface parking facilities throughout the campus. Impacts to the existing parking supply as well as accommodations for project-generated parking demand are discussed in this section. Transit impacts and the improvements to the pedestrian environment resulting from the construction of the ESC are discussed.

PROJECT TRIP GENERATION

This section of the DPIR discusses the project impacts in terms of new trips generated to the campus by the proposed Engineering Science Center (ESC). Projected vehicle, transit, and pedestrian-trip generation is presented. These projections are based on the number of new employees expected as a result of the ESC as well as trip generation rates available from the Institute of Transportation Engineers (ITE).[3] As described below, the number of new vehicle, transit and pedestrian trips resulting from the project is expected to be small. The impacts associated with the development of the ESC consist primarily of vehicle and parking impacts resulting from the elimination of 156 on-site parking spaces.

Person Trip-Generation

The number of new person-trips generated by the proposed project is directly related to the increase in staff associated with the development. According to Northeastern University, the number of persons employed at the ESC upon completion will vary depending on the research projects in progress. At peak, up to 150 people will work in the ESC. Of these employees, a handful of new positions will be created, while a majority of the positions will be transfers from within the University community. The University estimates that only six new

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3/ *Trip Generation*; An Informational Report, 5th Edition; Institute of Transportation Engineers; 1991.

employees will be located at the ESC. No increase in student enrollment is expected as a result of the project.

The ITE Trip Generation report presents vehicle-trip generation rates per employee for Research and Development activities (Land Use Code 760). ITE rates assume a vehicle occupancy rate (VOR or people per vehicle) of 1.20 persons per vehicle. Because the mode splits and VOR for this development differ from that used by ITE due to the site's urban location and availability of public transportation, the vehicle-trip generation rates in the manual were first converted into person-trip generation rates. This was done by multiplying the vehicle-trip generation rates by the VOR from the manual (1.20 people per vehicle) and adding it to the transit trip generation rate per employee for this type of land use. ITE vehicle-trip generation rates, the calculated person-trip generation rates and the total number of new person trips expected to be generated by the project are presented in Table 3. As shown, a total of 20 new daily person trips are expected as a result of the ESC. Of these, four are expected during the morning peak hour and three are expected during the evening peak hour.

Table 3 **Person-Trip Generation**

ITE Vehicle-Trip Rates (ITE Land Use Code 760):

	Entering	Exiting	Total
Daily	1.335	1.335	2.67
Morning Peak Hour	0.36	0.07	0.43
Evening Peak Hour	0.06	0.35	0.41

Person-Trip Rates* (Per Employee):

	Entering	Exiting	Total
Daily	1.60	1.60	3.20
Morning Peak Hour	0.46	0.09	0.55
Evening Peak Hour	0.08	0.45	0.53

Total Person-Trip Ends (with 6 new employees):

	Entering	Exiting	Total
Daily	10	10	20
Morning Peak Hour	3	1	4
Evening Peak Hour	0	3	3

Source: ITE Trip Generation; vehicle-trip rates adjusted to account for vehicle occupancy and transit trips and Northeastern University.

* Represents ITE vehicle-trip generation rates for Land Use Code 760 which has been adjusted to reflect vehicle occupancy and transit use.

Vehicle and Transit-Trip Generation

The determination of total person-trip generation is followed by the assignment of person trips to the appropriate mode of transportation (i.e. automobile, transit, or walk/bike). Mode splits vary between different land uses due to the specific trip making characteristics related to the land use. Mode split and vehicle occupancy is also heavily influenced by the location of the development, especially in terms of vehicle and transit accessibility and parking availability and price.

The ESC site is located adjacent the the MBTA's Orange Line rapid transit facility (Ruggles Station) which serves as a major link to the rapid transit network for commuter rail connections to the southwest and feeder bus connections from areas within Boston, mostly to the southeast, southwest and Cambridge. In addition, the site is located within easy walking distance of the E Branch of the MBTA's Green Line which travels along Huntington Avenue as well as numerous MBTA bus routes.

Table 4 presents an estimate of the mode split ratios and vehicle occupancy rate expected for the Northeastern University Engineering Science Center, given the unique availability of transit adjacent to the site. These rates were previously used for a similar land use for the Ruggles Center EIR which is also located adjacent to the MBTA Ruggles Station.

Table 4 **Mode Split and Vehicle Occupancy Rate (VOR)**

Mode of Travel	Percent
Automobile	46
Transit	44
Walk/Bike	10
VOR	1.24

Source: Table II A-8, Trip Making Characteristics by Land Use to Ruggles Center (Lower Roxbury); Ruggles Center Final Environmental Impact Report (EOEA No. 6133), Kramer Associates, Watertown, MA; October 1989.

These mode splits were applied to the total person trips presented in Table 3. The resulting new vehicle, transit, and walk trips expected to be generated by the ESC project are presented in Table 5. As shown, the project is expected to generate a total of eight new daily vehicle trips, eight new daily transit trips, and two new daily walk trips. New peak hour vehicle, transit and pedestrian trips are almost negligible.

Based on these results, it is clear that traffic and parking impacts of the project are primarily associated with the relocation of the existing parkers from the 156-space surface parking facility on the project site to the 995-space garage on Columbus Avenue and other surface facilities on campus.

Table 5 **Estimated Project-Generated Trips**

	Entering	Exiting	Total
Vehicle Trips:			
Daily	4	4	8
Morning Peak Hour	1	0	1
Evening Peak Hour	0	1	1
Transit Trips:			
Daily	4	4	8
Morning Peak Hour	1	0	1
Evening Peak Hour	0	1	1
Walk Trips:			
Daily	1	1	2
Morning Peak Hour	0	0	0
Evening Peak Hour	0	0	0

Source: Developed from person trips and mode split and VOR information presented in Tables 3 and 4.

VEHICLE-TRIP DISTRIBUTION

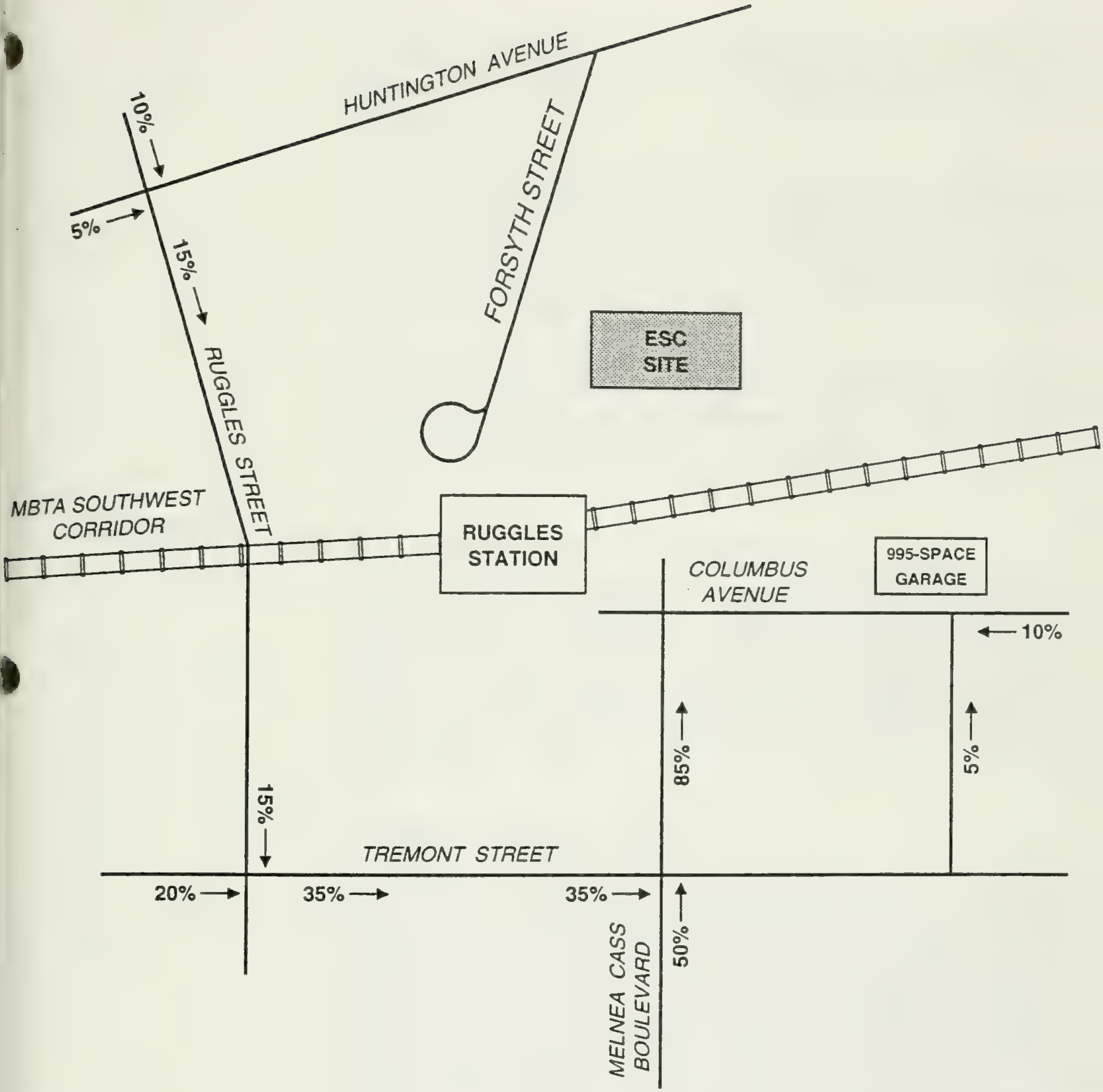
Vehicle-Trip distribution data was extracted from the Ruggles Center Final Environmental Impact Report[4] and is presented in Figure 2. The vehicle-trips generated by the ESC and those relocated from the existing parking facility on the site were assigned to the roadway network according to this distributions.

PARKING

This section discusses the project-generated parking demand, the impacts of the ESC project on the existing parking supply and Northeastern University's plans to accommodate the increased demand and changes in the parking supply.

New parking demand generated by the project is directly related to the vehicle-trip generation previously discussed. As noted previously, the vehicle-trip generation estimates were made based on six new employees in the proposed building. As presented earlier in Table 5, a total of four new vehicles are expected to enter the campus daily as a result of construction of the ESC, therefore, the projected increase in parking demand resulting from the ESC is estimated at four spaces. New parking demand associated with the ESC will be accommodated in the 995-car Northeastern University parking garage located across the MBTA Southwest Corridor from the Project site and in other existing surface parking lots throughout the campus.

4/ Ruggles Center Final Environmental Impact Report (EOEA No. 6133); Kramer Associates, Watertown, MA; October 1989.



Source: Ruggles Center FEIR, EOEA No. 6133;
Kramer Associates; Watertown, MA; October 1989.

Vehicle-Trip Distribution Figure 2

Construction of the ESC will also result in the elimination of the 156-space surface parking facility on the site, the Hayden Lot. Vehicles currently parking in the Hayden Lot will be relocated to the 995-car parking garage and other surface parking lots.

Northeastern has accounted for the increased parking demand associated with the ESC and the elimination of the Hayden Lot in its long range planning as part of its Master Plan through the construction of the 995-car parking garage (completed on Columbus Avenue in 1987). This facility is located across the MBTA Southwest Corridor from the project. The garage and other surface facilities have sufficient capacity to accommodate both the new and displaced parking demand associated with the ESC project.

As part of its Master Plan, Northeastern University continues to investigate new parking facilities. Northeastern University has also implemented a number of parking demand reduction and management strategies in order to reduce existing on-campus parking demand. These strategies are discussed in the Development of Mitigation Measures section of this report.

TRAFFIC

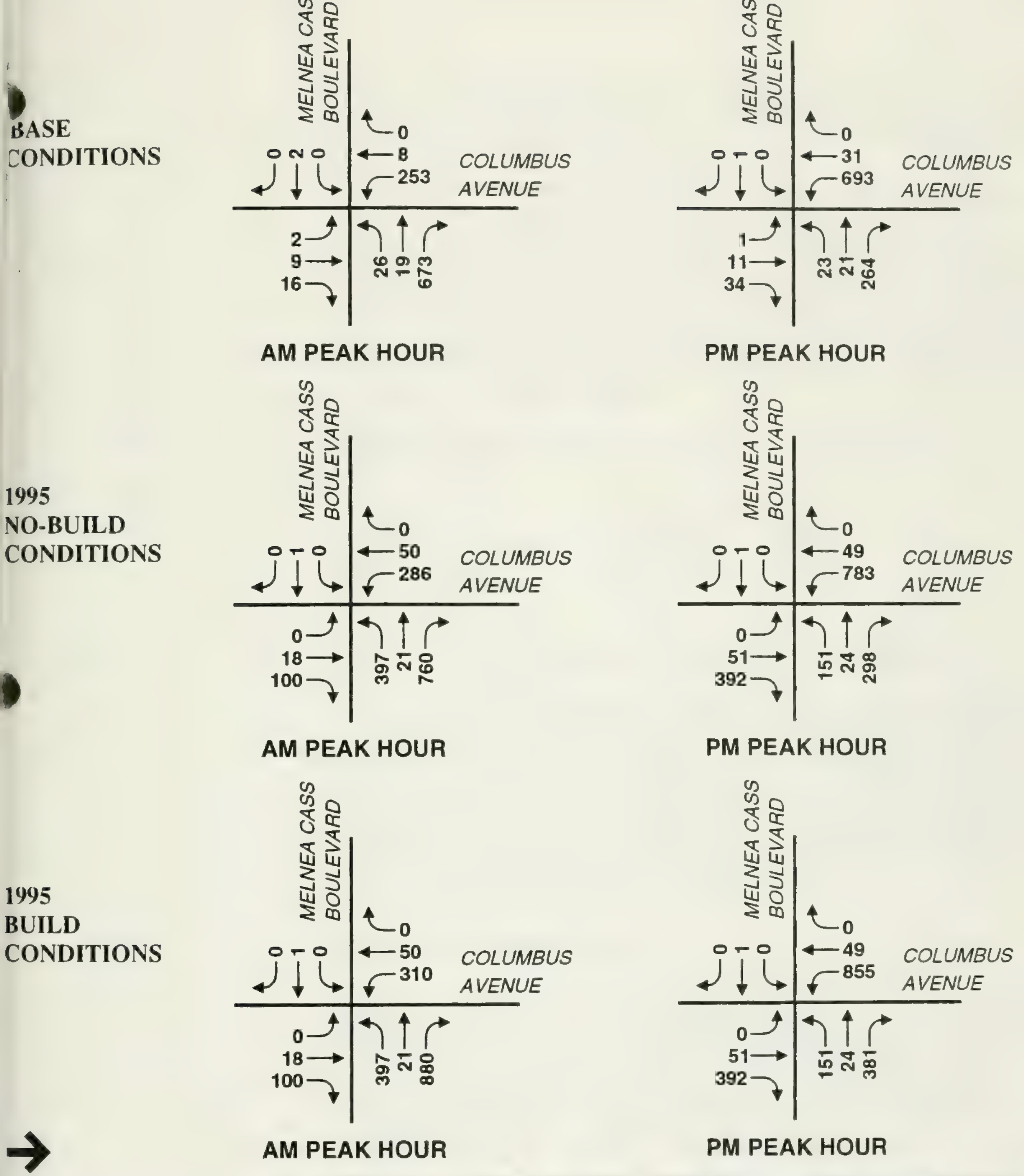
In this section are the projected traffic volumes at the intersection of Columbus Avenue and Melnea Cass Boulevard under No-Build and Build Conditions. The magnitude of traffic volume shifts resulting from the relocation of existing parking on the ESC site are presented. The results of the future No-Build and Build Condition level-of-service analysis for the intersection of Columbus Avenue and Melnea Cass Boulevard and an evaluation of the project's impacts on the peak hour operation of this intersection are also presented in this section of the DPIR.

Future No-Build Traffic Volumes

Forecasts of future 1995 No-Build Condition traffic volumes at the intersection of Columbus Avenue and Melnea Cass Boulevard were taken from the Ruggles Center EIR as directed by the BTD. The "Build" traffic volumes for the Ruggles Center EIR represent "No-Build" traffic volumes for the ESC project because Ruggles Center is assumed to be almost complete and occupied by the Build year (1995) for the ESC. The other planned projects (background developments) expected to be on line by the ESC build year are listed in the Appendix. The Ruggles Center EIR traffic volume projections accounted for regional growth associated with development outside the general vicinity of the project, such as in the Longwood Medical Area (LMA), by applying a growth rate to through traffic moves. No-Build traffic volumes for the morning and evening peak hours are presented in Figure 3. These volumes were used to conduct the level-of-service analysis for the No-Build Conditions.

Future Build Traffic Volumes

Future Build traffic volumes were calculated by adding relocated vehicle trips from the existing parking facility on the site and new vehicle trips generated by the development of the ESC to the No-Build traffic volumes projected for the



Vanasse Hangen Brustlin, Inc.

Peak Hour Traffic Volumes

Figure 3

intersection. As previously discussed, the traffic impacts resulting from the development of the ESC are primarily associated with the relocation of displaced parkers currently parking on-site.

The magnitude of the traffic volume shifts resulting from the construction of the ESC, which will eliminate the existing lot on the site, was determined by conducting peak hour traffic counts of vehicles entering and exiting the lot. Northeastern University faculty and staff use the lot on a first come/first serve basis, therefore the lot fills early and remains full throughout the day. Because of these utilization patterns, the number of peak hour entering trips account for a large percentage of the total parking supply in the facility. Afternoon patterns reflect the departure of day faculty and staff and the arrival of evening faculty and staff. Table 6 presents the peak hour vehicle trips that will be relocated from the site to the 995-car garage.

Table 6 **Peak Hour Vehicle Trips to be Relocated From Existing Parking Facility on Site**

Peak Hour	Entering	Exiting	Total
Morning Peak Hour	140	28	168
Evening Peak Hour	98	84	182

Source: Vanasse Hangen Brustlin, Inc. peak hour traffic counts, January, 1993.

New vehicle trips resulting from the construction of the ESC were added to the vehicle trips that will be relocated as a result of the elimination of the existing parking facility on the site. These total peak hour vehicle trips were routed to the 995-car garage across the MBTA's Southwest Corridor according the the trip distribution presented earlier. The resulting traffic volumes at the intersection of Columbus Avenue and Melnea Cass Boulevard under Build conditions are presented in Figure 3. These volumes were used to conduct the level-of-service analysis during both peak hours under Build conditions.

Level-of-Service Analysis Results

Level-of-service analyses were conducted for the intersection of Columbus Avenue and Melnea Cass Boulevard using the same procedure as described for the Base Condition analysis. These analyses were conducted for morning and evening peak-hour traffic operations under No-Build and Build conditions. Table 7 summarizes the results of the level-of-service analyses and presents a comparison of these results between Base, No-Build and Build conditions. Detailed analysis results are presented in the Appendix.

Table 7 **Future Level-of-Service Analysis Results - Columbus Avenue and Melnea Cass Boulevard**

	Morning Peak Hour			Evening Peak Hour		
Condition	V/C*	Delay**	LOS***	V/C	Delay	LOS
Base Condition	0.57	5	A	0.58	5	A
No-Build Condition	0.68	11	B	0.73	18	C
Build Condition	0.78	11	B	0.76	18	C

Source: Vanasse Hangen Brustlin, Inc.
* Volume-to-capacity ratio.
** Average stopped delay per vehicle in seconds.
*** Level of service.

As shown in Table 7, the intersection of Columbus Avenue and Melnea Cass Boulevard operates at LOS A during morning and evening peak hours under Base conditions. Under No-Build conditions, the intersection is predicted to operate at LOS B during the morning peak hour and LOS C during the evening peak hour. The analysis procedure, input parameters and results for the Base and No-Build conditions are consistent with those presented in the Ruggles Center EIR. Under Build Conditions, the intersection is expected to remain at LOS B in the morning peak hour and LOS C in the evening peak hour. The new traffic entering the intersection resulting from the ESC project construction (new and relocated traffic) is not expected to significantly affect the peak hour operations of this intersection.

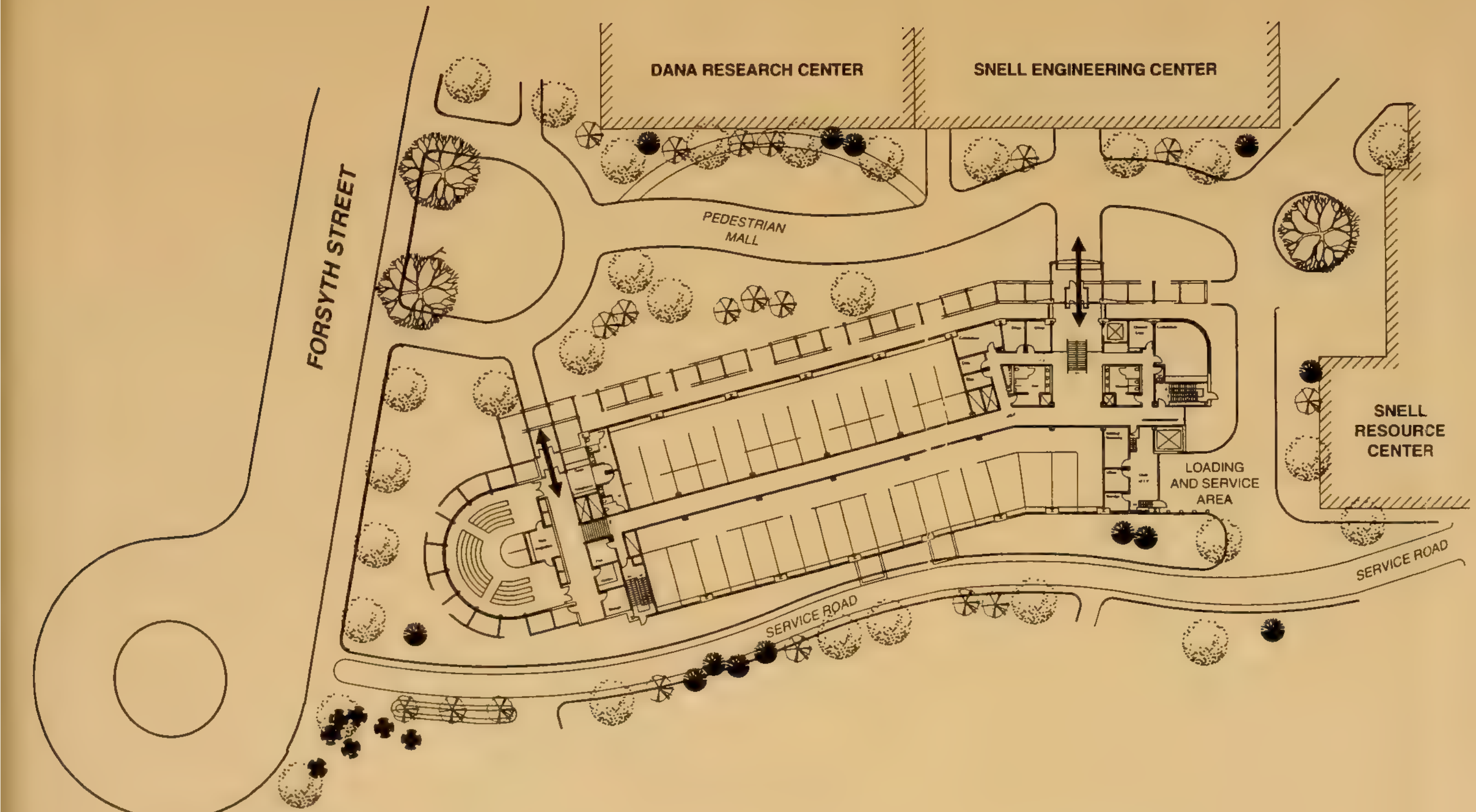
SERVICE VEHICLES

Figure 4 illustrates the proposed site plan for the Engineering Science Center. As shown, loading activity will occur in the loading and service area at the northeast corner of the building. The loading and service area is accessed via the service road east of the building which travels along the MBTA Southwest Corridor and behind the Snell Resource Center. No loading activity will take place on public streets.

TRANSIT

As stated previously, the ESC project is expected to generate a total of eight new daily transit trips. Given the extensive public transportation service available to and from the site, the total transit trip generation resulting from the project will be spread out over numerous different public transportation options and the project is not expected to cause noticeable impacts on any of the rapid transit, commuter rail or bus routes serving the area.

↔ Primary Pedestrian Access to Building



Source: Cannon Boston, Inc.

Vanasse Hangen Brustlin, Inc.

Figure 4

Northeastern University
Engineering Science Center
Pedestrian and Service
Vehicle Access

PEDESTRIANS

The ESC project will improve the pedestrian environment in the area of the project and for the campus in general. Elimination of the Hayden Lot will reduce the number of vehicles using Forsyth Street and therefore reduce the potential for vehicle-pedestrian conflicts in the vicinity of the ESC. The building design is intended to promote the construction of an east-west oriented landscaped pedestrian mall anchored at the Snell Resource Center (See Figure 4). The mall exhibits a cross-sectional dimension (approximately 85-feet) that is necessary for it to function as the major organizational spine to the campus. An open lawn, broad walks and canopy trees along the edges will be used to provide definition to the mall space in concert with new and existing buildings which will frame and scale the space.

EVALUATION OF SHORT-TERM IMPACTS (CONSTRUCTION PERIOD)

This section describes the short-term impacts during construction of the ESC. Following normal practice in Boston, Northeastern will prepare a construction management plan that will incorporate the specific measures intended to minimize the impact of construction on adjacent roadways. Northeastern University will submit its plan to the Boston Transportation Department for approval. Approval from the City will be obtained before the commencement of construction of the Project.

CONSTRUCTION SCHEDULE, WORK HOURS AND ACCESS

At this time, a detailed construction schedule has not been produced. It is expected that the duration of the construction will be eighteen (18) months. The normal work day will begin at 7:00 AM and end at 6:00 PM. The work force will vary greatly during the construction period depending on such variables as schedule and weather. During the anticipated 18 month construction period, the average daily work force will range from 40 to 50 individuals. As the project nears completion, an increase in the daily work force to about 80 individuals would be expected for a limited period of 1 to 2 months.

ACCESS ROUTE AND VOLUME OF CONSTRUCTION VEHICLES

The primary access route to the site will be Forsyth Street. The secondary access route will be the Gainsbourough Street/St. Botolph Street entrance to the campus. It is anticipated that a minimum number of vehicles servicing the general contractor, perhaps 3 to 5 per day, will be on the construction site. During the construction period, delivery related vehicle activity will account for approximately 20 vehicle-trips per day, with an increase to 40 trips during the peak construction period in months 9 through 12.

STAGING AREAS AND PARKING

Construction staging will primarily be located within the construction site. Adjacent areas might also be put to use for short term storage of material such as precast concrete panel staging. Secure site fencing will isolate the staging area/construction area from adjacent University and public space. No on-site parking will be specifically reserved for construction worker's vehicles. As a

matter of policy, the University strongly encourages the use of public transportation by its general contractors and their work forces.

PEDESTRIAN SAFETY

This project will enhance the pedestrian environment surrounding the project site, as well as the campus in general. During construction, the site will be securely fenced with locked gates. Pedestrian movement will be accommodated on the sidewalks adjacent to the site. The building access and landscaping improvements in the vicinity of the site will be designed to coordinate with surrounding uses and structures, improving the overall pedestrian environment.

NOISE

The University will intensively manage the construction process so that construction noise will be kept to a minimum. This is primarily because the three adjacent structures to the site are teaching facilities or libraries. Excessive noise would adversely impact the quality of the teaching environment in the area.

DUST CONTROL

Excavated site material will be the principle source of dust. Northeastern University will require the general contractor to utilize methods such as surface wetting of materials and covering of stored materials to minimize the impacts of dust and to maintain the site in the cleanest state practicable.

DEBRIS DISPOSAL

Construction debris and excavate will be disposed of in accordance with all applicable municipal, state and federal laws, regulations and ordinances. If possible in terms of schedule, bituminous paving excavated from the site will be recycled.

RODENT CONTROL

Northeastern University intends to engage a reputable rodent control firm, as it has done in the past, to perform the task of on-going rodent control during the construction process.

DEVELOPMENT OF TRANSPORTATION MITIGATION MEASURES

This section summarizes on-going transportation mitigation actions by Northeastern University. The University has long recognized the need to plan and coordinate activities intended to alleviate traffic problems for the institution and neighborhood residents. For this reason, Northeastern has created a University-wide Transportation Committee made up of faculty, students and administrators. Northeastern has implemented the following measures in order to mitigate traffic concerns in its campus area:

- To alleviate traffic congestion during the summer months, the University has implemented a four-day work week.
- The University has arranged a staff work schedule to allow varied work schedules during school vacation periods.

Northeastern University recognizes that it must encourage as much transit use as possible but must also provide adequate parking for commuting students and staff. The long-term parking strategy established by the Campus Master Plan[5] has three basic elements:

- Locate the bulk of the parking in parking garages on the campus periphery and eliminate all but service and visitor parking within the campus core. In addition to the 995-car garage on Columbus Avenue, the University is currently investigating the construction of a garage on Ruggles Street.
- Provide a geographically balanced parking supply that responds to commuting student origins and street system constraints. Parking facilities will be distributed in three sectors of the campus (west of Forsyth Street, south of the Southwest Corridor and east of existing campus development) to evenly distribute the University traffic destinations. This will also provide parking in location convenient to all campus areas.
- Provide structured parking only when necessary in increments that are cost effective (a minimum of 400 to 500 spaces).

Northeastern University recognizes its unique location with respect to public transportation facilities and services. As such, it encourages the use of public transportation by students and staff. The following measures illustrate the

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5/ Northeastern University Boston Campus Master Plan, Sasaki Associates, September, 1987.

University's commitment to encouraging the use of public transportation:

- Northeastern University has actively participated in the MBTA pass program for several years. Currently approximately 750 employees of the University utilize the program. Passes are also made available to students of the University.

- Northeastern encourages use of mass transit by periodically distributing information including MBTA maps, schedules and fare rates to all employees and students. In its recruiting material for prospective students, the University stresses its accessibility by public transportation.

- The University has devoted substantial efforts to improving public transportation service to the Northeastern campus and the neighborhood.

The mitigation programs now on site will be extended to the proposed ESC site.

CONCLUSION

The proposed Northeastern University Engineering Science Center (ESC) is expected to have negligible effects on the peak hour traffic operations in the area and at the intersection of Columbus Avenue and Melnea Cass Boulevard. The University has planned for the development of the ESC in its Master Plan and will accommodate the parking needed for the project in the existing Columbus Avenue Garage.

The site is well served by public transportation with the MBTA Ruggles Station adjacent to the site. Pedestrian conditions in the vicinity of the site will improve as a result of the development of the ESC. The project includes the construction of a landscaped pedestrian mall.

Northeastern University recognizes the importance of minimizing any potential impacts on the transportation system serving the area. Although the project itself is not expected to have a significant effect on traffic operations, the University's parking system, or the transit system serving the site, the University has an on-going transportation mitigation program which is intended to alleviate traffic related problems for the University and neighborhood residents. This program will be extended to include the ESC site.

3. ENVIRONMENTAL PROTECTION

a. Shadow Analysis

b. Air Quality

c. Geotechinical Impact

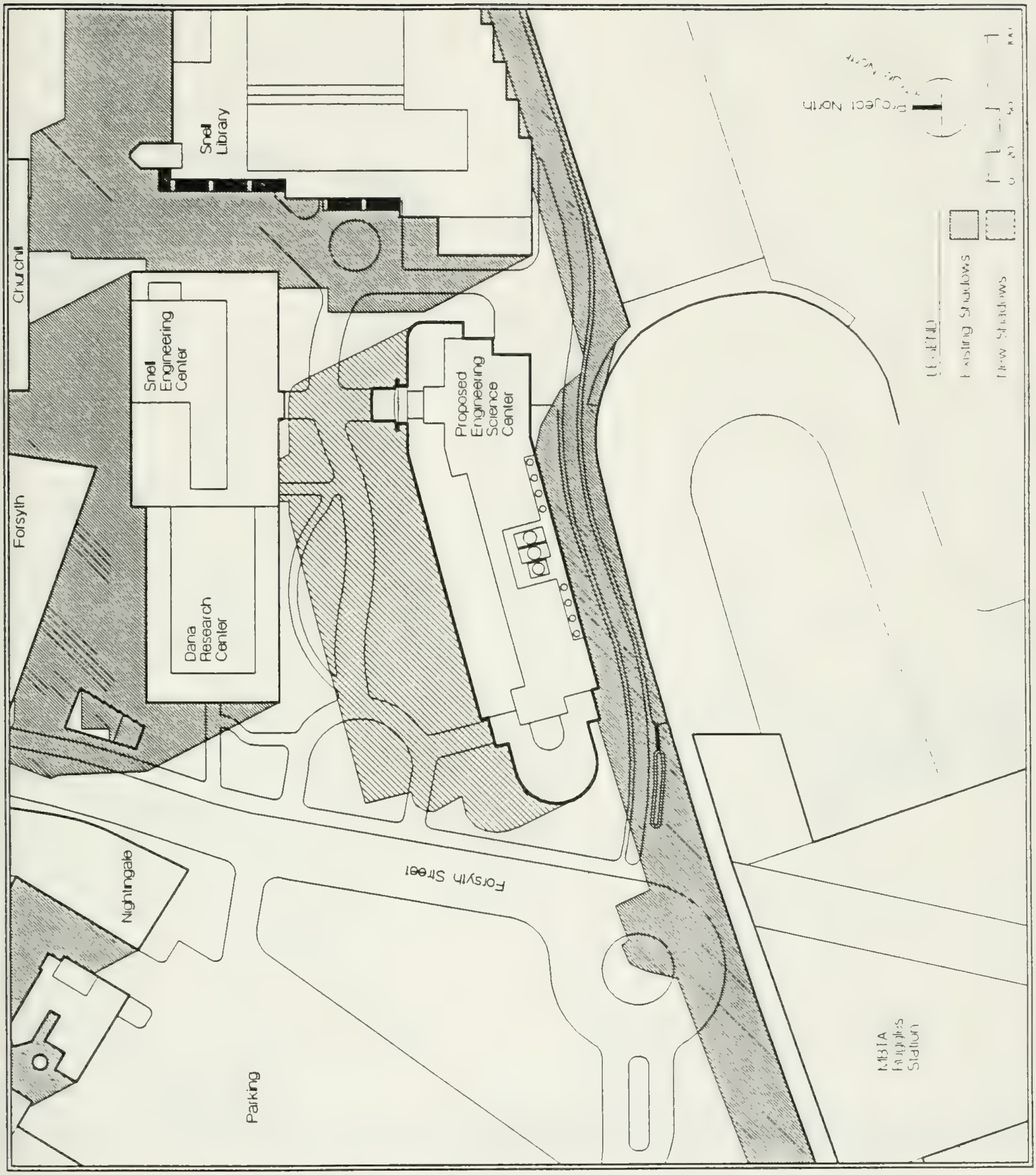
d. Solid And Hazardous Waste

e. Water Quality

f. Noise

g. Construction Impacts

a. Shadow Analysis

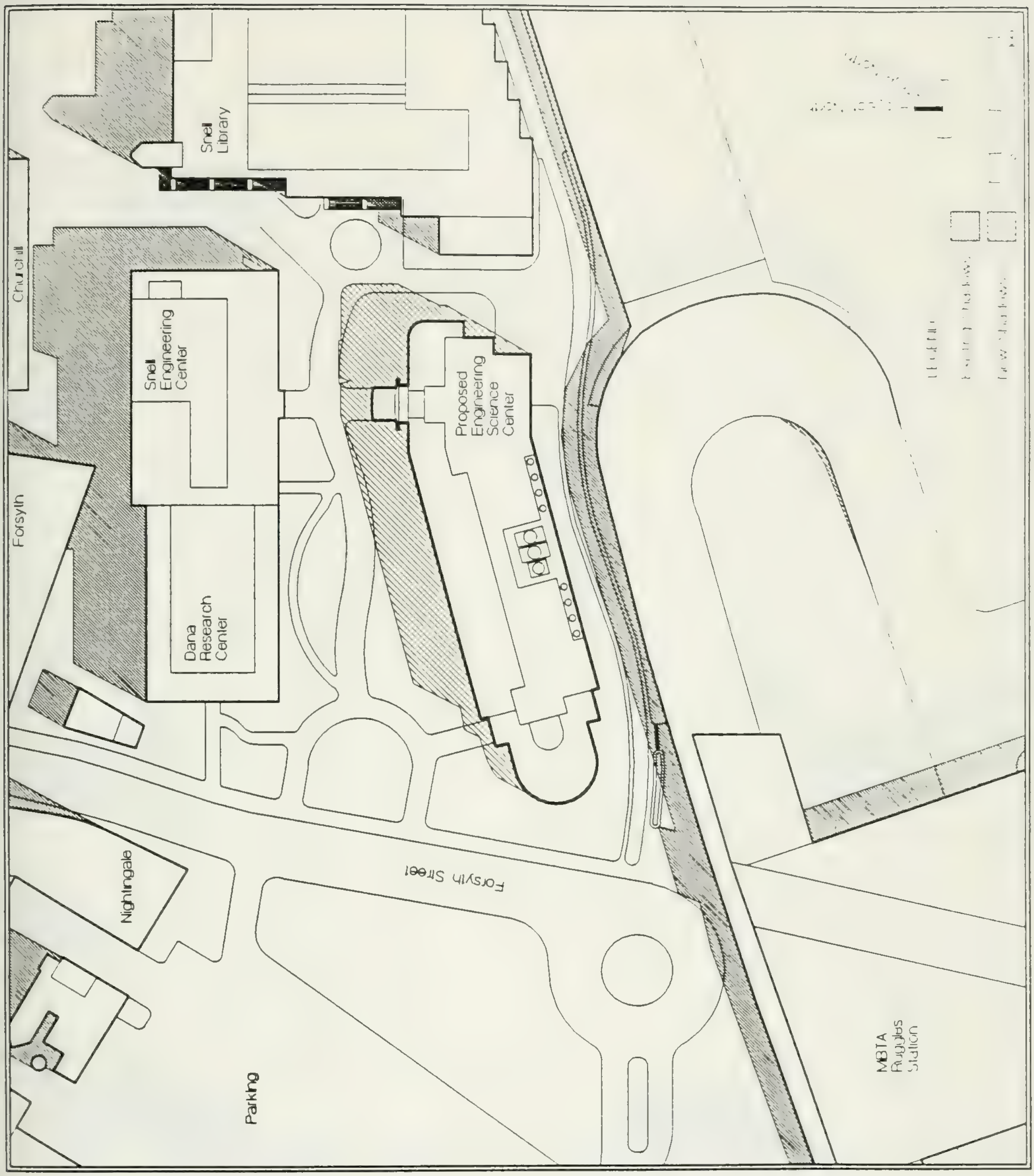


March 21 - 9:00 AM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

SHADOW STUDIES

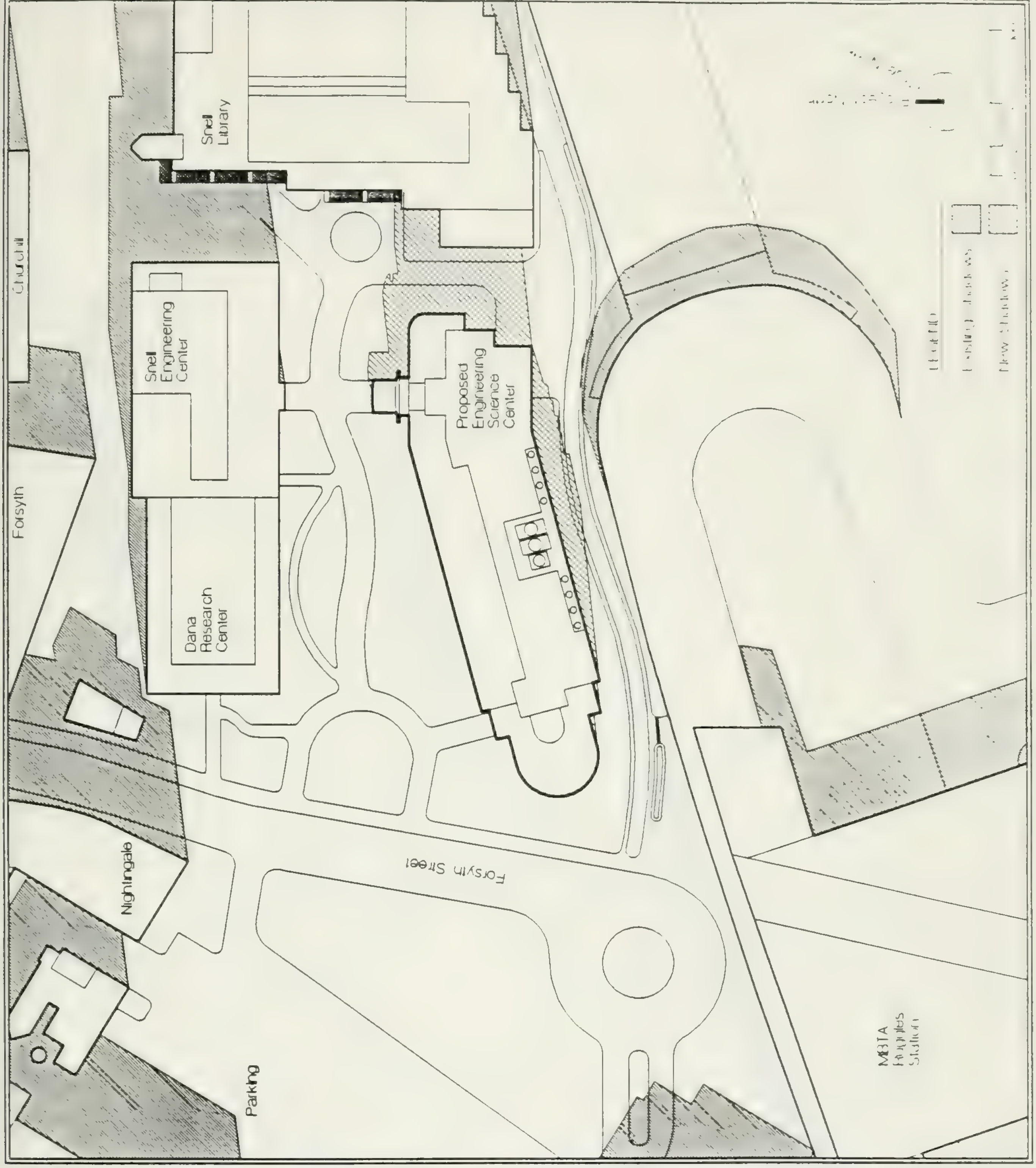


March 21 - 12:00 PM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

SHADOW STUDIES

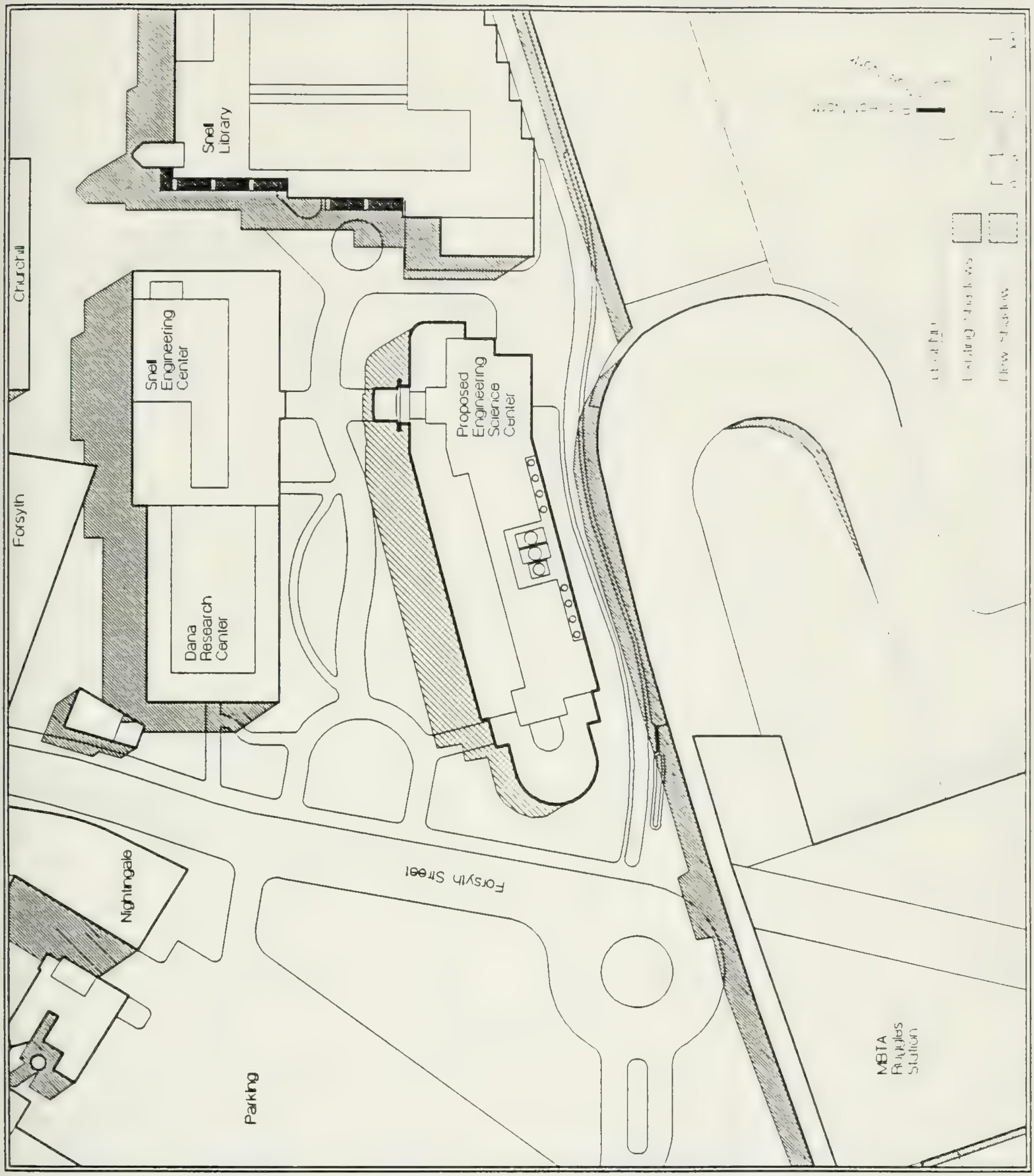


March 21 - 3:00 PM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

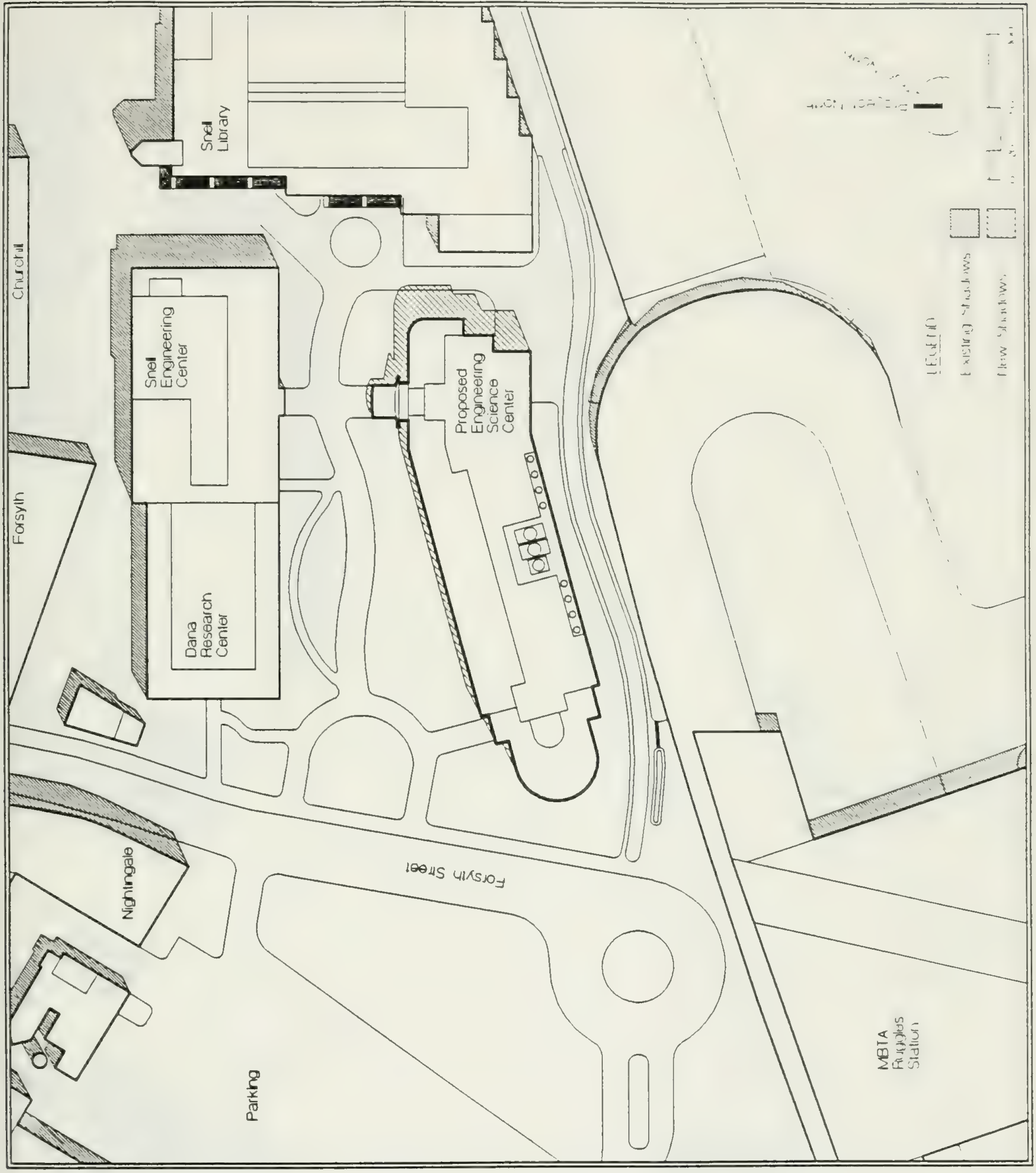
SHADOW STUDIES



June 21 - 9:00 AM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

SHADOW STUDIES

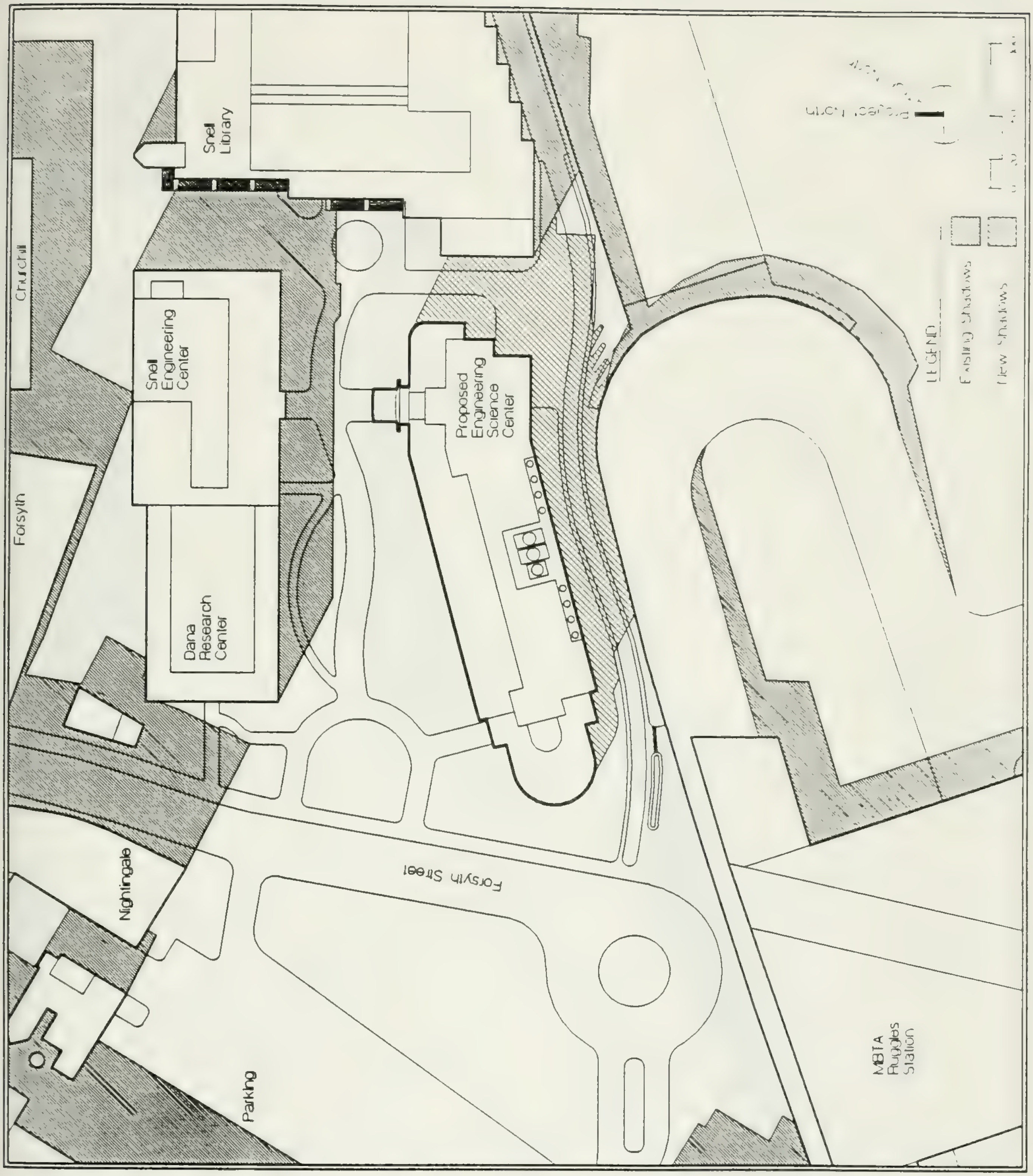


June 21 - 12:00 PM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

SHADOW STUDIES



June 21 - 3:00 PM

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ENGINEERING SCIENCE CENTER

CANNON

SHADOW STUDIES

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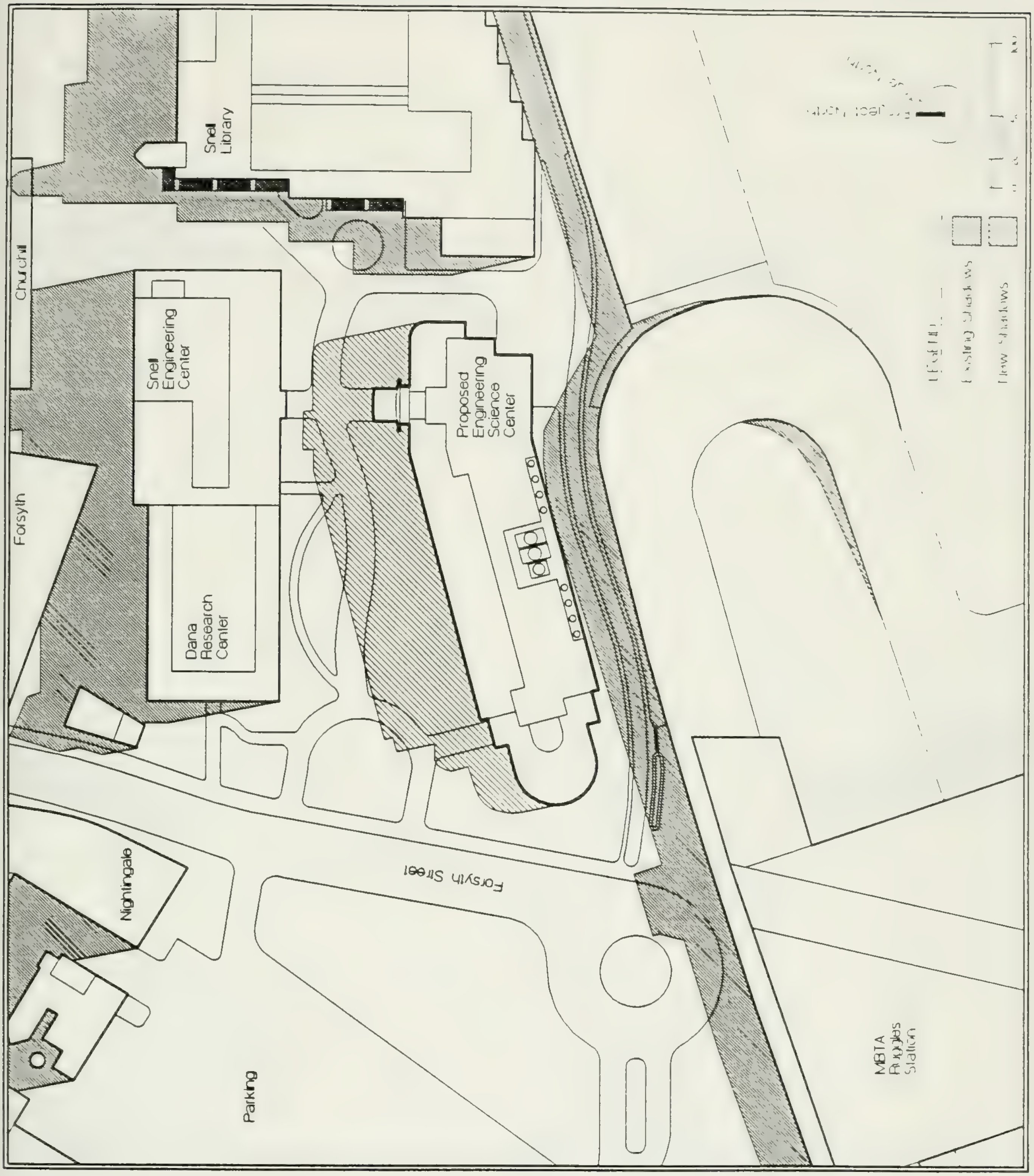

September 21 - 9:00 AM

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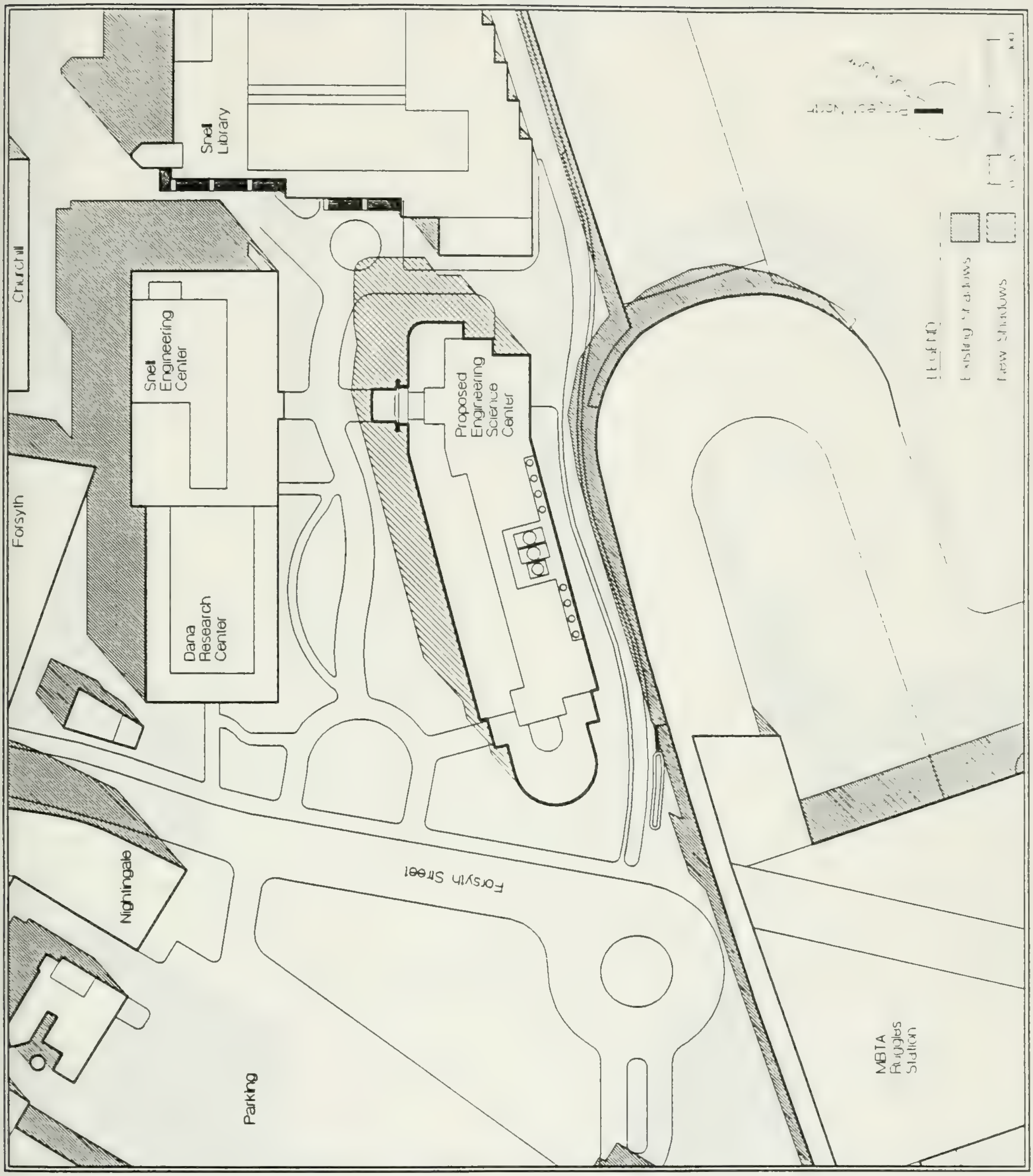
ENGINEERING SCIENCE CENTER

SHADOW STUDIES



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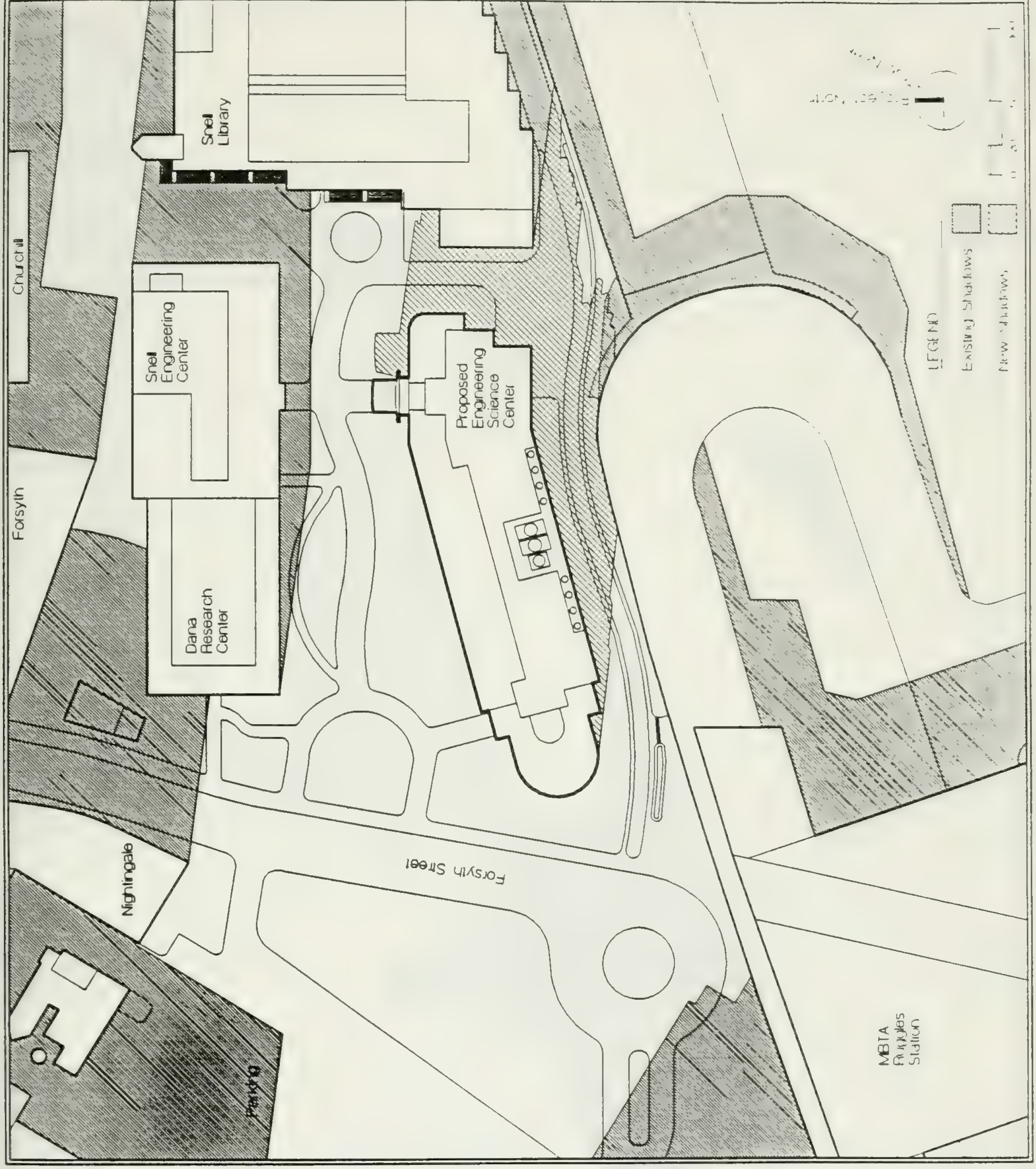
ENGINEERING SCIENCE CENTER

SHADOW STUDIES



September 21 - 3:00 PM

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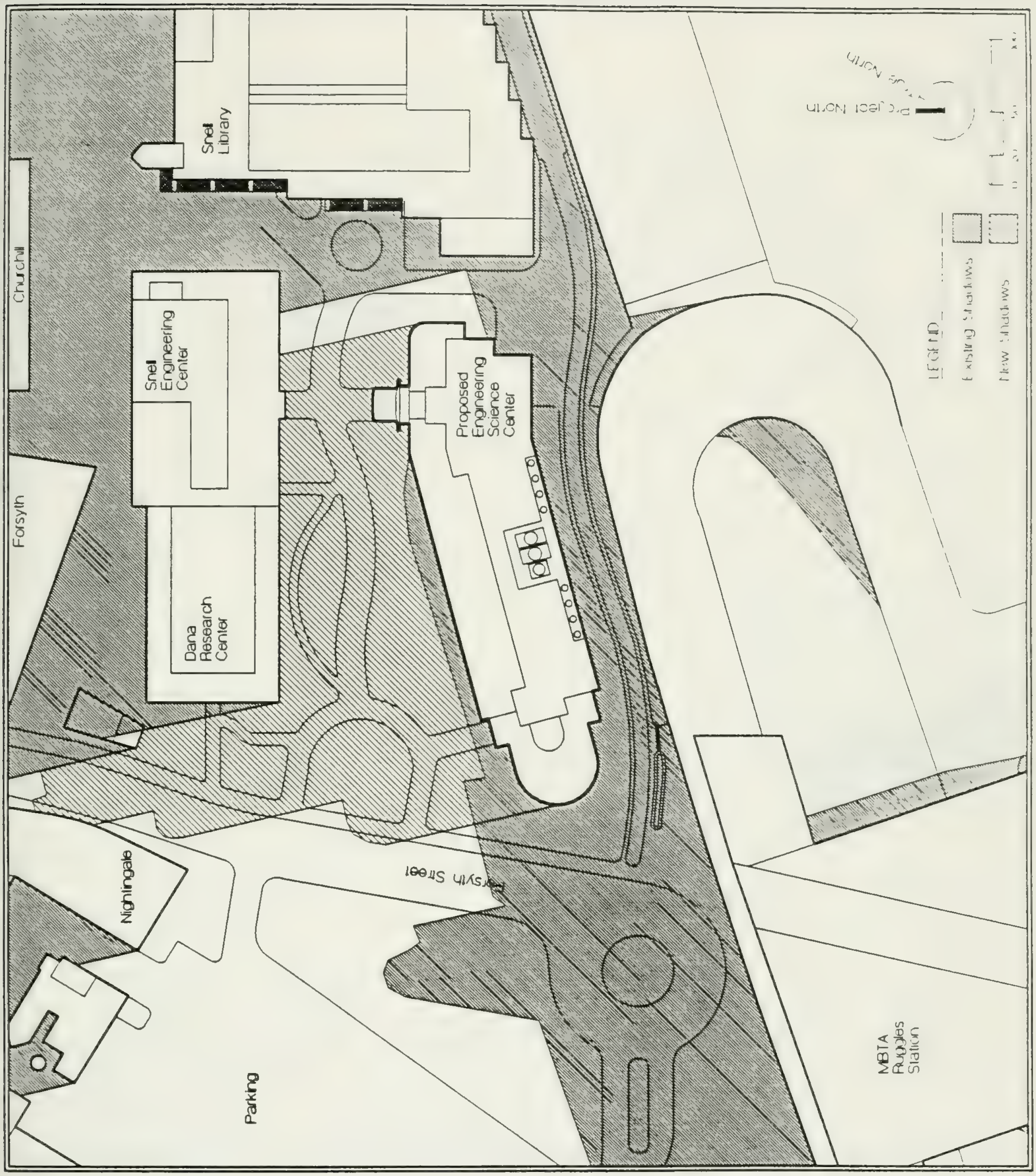
ENGINEERING SCIENCE CENTER

CANNON

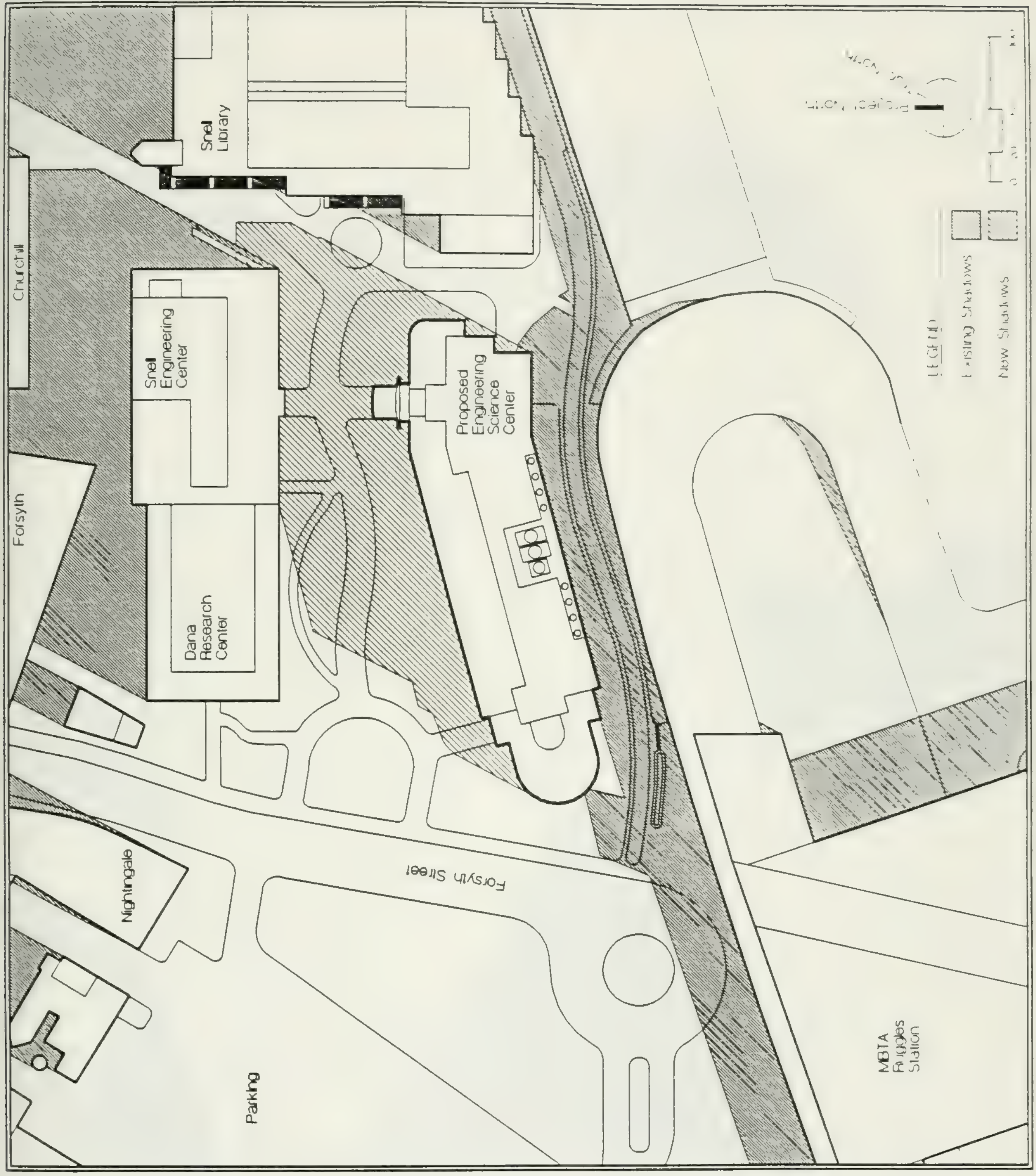
SHADOW STUDIES



December 21 - 9:00 AM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

SHADOW STUDIES

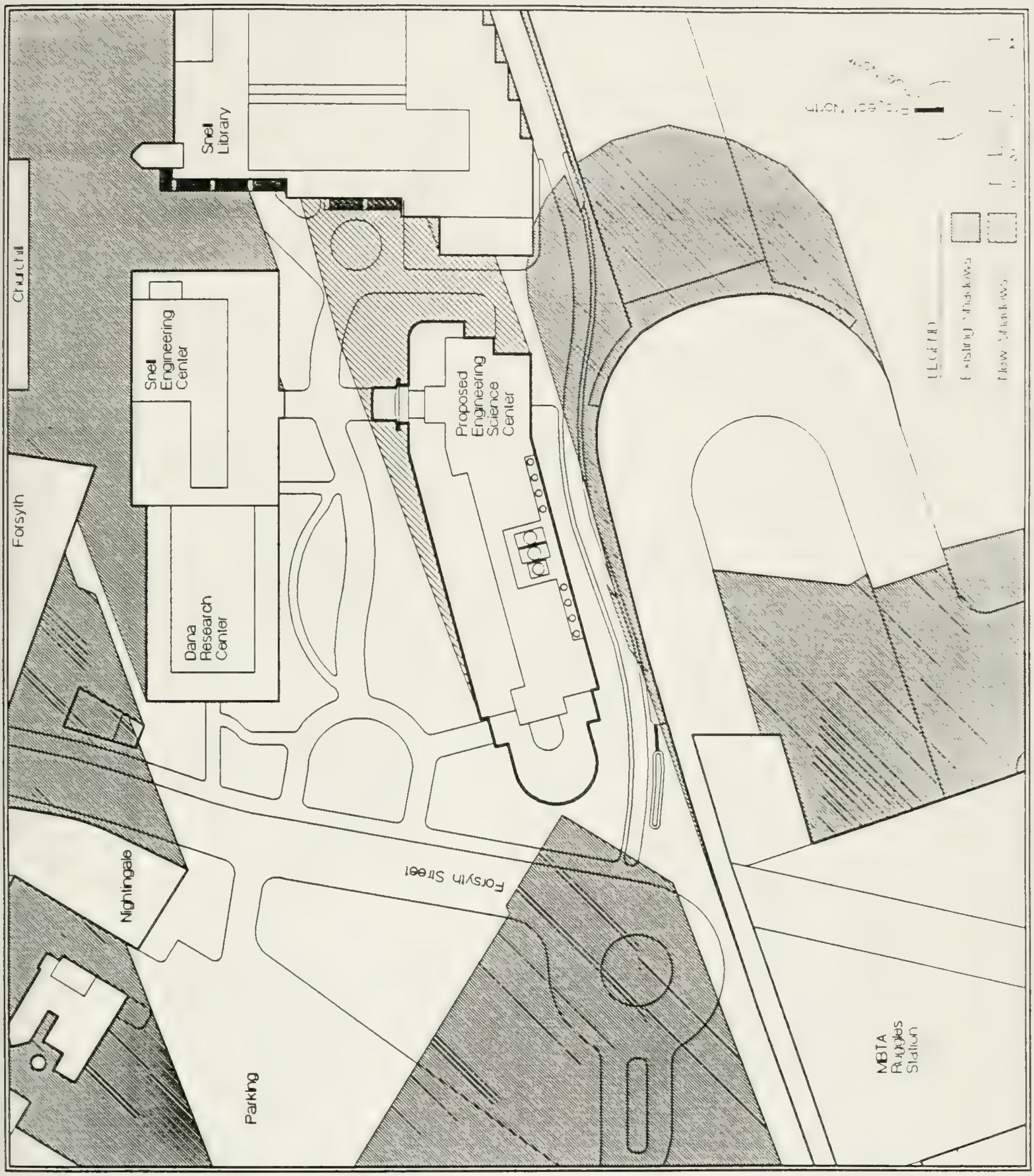


December 21 - 12:00 PM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

SHADOW STUDIES



December 21 - 3:00 PM

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

SHADOW STUDIES

b. Air Quality

DRAFT REPORT

MICROMETEOROLOGY AND REENTRAINMENT EVALUATION FOR THE PLANNED ENGINEERING SCIENCE CENTER AT NORTHEASTERN UNIVERSITY

DAVID W. BEARG, P.E.
LIFE ENERGY ASSOCIATES
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CONCORD, MASSACHUSETTS 01742
508 369-5680

MARCH, 1992

1.0 Introduction

This document summarizes the results of the effort to perform the following two determinations for the planned Engineering Science Center:

1) The optimum air intake location, and
2) The optimum stack configuration, location and minimum height requirements.

The air intake evaluation is based on determinations of the potential impacts of air contaminants from the following nearby sources:

A) Laboratory Exhausts of the Snell Engineering Building
B) Laboratory Exhausts of the Dana Physics Building
C) Laboratory Exhausts of the Richards Building
D) Laboratory Exhausts of the United Realty Complex: Lake, Holmes, & Nightingale Buildings
E) Laboratory Exhausts of the Hurtig Chemistry Building
F) Laboratory Exhausts of the Mugar Science Building
G) Laboratory Exhausts of the Forsyth Building
H) Bus Exhausts at the Ruggles MBTA Station
I) Vehicle Exhausts at the Northeastern Parking Garage

The stack evaluation is based on determinations of the potential impacts on the air intakes of the following nearby buildings:

A) The Snell Engineering Building,
B) The Dana Physics Building,
C) The Library Resource Center,
D) The Ell Student Center,
E) The Hayden Building,
F) The Churchill Building,
G) The Forsyth Building,
H) The Northeastern Parking Garage
I) An Office Building Built on Parcel 18

This report is organized so as to first present an executive summary, followed by sections on the evaluation procedure and descriptions of the emission characteristics and expected site impact for each the above identified sources. This is followed by a section of the evaluation of the planned new stacks of the Engineering Science Building on the nearby air intakes.

2.0 Executive Summary

CONCLUSION #1: The review of the current and expected level of chemical usage in Northeastern University's laboratory fume hoods indicates that the Dilution Goal used for the Mugar and Hurtig reentrainment studies is still appropriate for this study. The specifics of the information on the current chemical usage is presented in Appendix A.

CONCLUSION #2: Based on the achievement of this Dilution Goal, the optimization of the placement of the air intakes for the planned Engineering Science Center at Northeastern University, SHOULD BE LOCATED ON THE NORTH SIDE OF THE PENTHOUSE MECHANICAL ROOM. The height of this penthouse should be at the level indicated in the preliminary drawings provided by Cannon.

This conclusion is based on the individual determinations concerning the separate identifiable sources of air contaminants in the vicinity of these planned air intakes which are presented and evaluated in Section 4 of this report.

CONCLUSION #3: With respect to the determination of the optimum stack configuration, location and minimum height requirements for the planned Engineering Science Center at Northeastern University, based on achieving an adequate degree of protection against reentrainment of air contaminants into nearby sources has yielded the following conclusion:

THE OPTIMAL CONFIGURATION FOR THE EXHAUST FROM THESE LABORATORY FUME HOODS HAS BEEN DETERMINED TO BE 4 STACKS OF 27,200 CFM EACH. THE MINIMUM STACK HEIGHT REQUIREMENT FOR THESE STACKS IS TEN (10) FEET ABOVE THE HEIGHT OF THE PENTHOUSE ROOF. THERE ARE NO LOCATIONAL RESTRICTIONS AS TO THE PLACEMENT OF THESE STACKS ON THIS ROOF.

The configuration of 8 stacks of 13,600 CFM each will also achieve the desired Dilution Goal and therefore may be utilized if there are significant cost savings with an 8 stack approach.

These conclusions are based on the evaluation of the requirements to minimize reentrainment for four separate options of stack configurations:

Option #1: 4 stacks of 27,200 cfm each (40 hoods/stack),
Option #2: 8 stacks of 13,600 cfm each (20 hoods/stack),
Option #3: 16 stacks of 6,800 cfm each (10 hoods/stack), or
Option #4: 32 stacks of 3,400 cfm each (5 hoods/stack).

A) The Snell Engineering Building

The Snell Engineering Building has 20 separate exhaust stacks connected to 20 separate laboratory fume hoods that are used by the Chemical Engineering and Civil Engineering departments. These stacks discharge above the penthouse of this building at a height datum of 97'-6". The exhaust volumes for this systems vary from 890 cfm for 14 of the systems up to 1,960 cfm for two of the systems, for a total discharge volume of 22,090 cfm.

The 890 cfm exhausts have stack heads of 9" in diameter, which yields a discharge velocity of 2,015 fpm. The 1,420 cfm exhausts have stack heads of 11" in diameter, yielding a discharge velocity of 2,152 fpm. The 1,960 cfm exhausts have stack heads of 13" in diameter which yields a discharge velocity of 2,126 fpm.

B) The Dana Physics Building

The Dana Physics Building is the home to the Semiconductor Processing Laboratory, which is located in rooms 336, 346, 348. In room 336 there are four hoods connected to one exhaust system with a discharge volume of 4,500 cfm. The stack itself is rectangular, with the dimensions 20.5" by 14", which is equivalent in area to a 19.1" diameter stack. This yields a discharge velocity of 2,257 fpm. In room 346 the discharged volume is 4,000 cfm through a stacktop diameter of 12". This yields a discharge velocity of 5,093 fpm. In room 348 the discharged volume is 4,500 cfm through a stacktop diameter of 12". This yields a discharge velocity of 5,730 fpm.

C) The Richards Building

The Richards Building has been identified as having 9 laboratory fume hoods. It has been reported that rooms 412 and 503 each have two hoods in them and rooms: 426, 434, 453, 455, and 459 each have one hood in them. An inspection of the area determined the following information. The hoods in rooms 426 and 503 are not currently in use. Room 412 has been remodeled into classroom space and no longer has any hoods. The hood in room 434, at 50" by 28" is estimated to discharge 980 cfm, based on the assumption of 100 fpm of air velocity across this opening. The hood in room 453, at 50.25" by 18", is estimated to discharge 630 cfm. The hood in room 455, at 50.5" by 25.25", is estimated to discharge 890 cfm.

D) The United Realty Building Complex: Lake, Holmes, & Nightingale

In the Lake Building, rooms 117, 118, and 119 were determined to have laboratory fume hoods used by the Biology Department. The hood in room 117, at 50.5" by 19" is estimated to discharge 670 cfm. The hood in room 118, at 30" by $17^{3}/_{8}$", is estimated to discharge 360 cfm. The hood in room 119, at 47.25" by 23.5", is estimated to discharge 760 cfm. The ductwork leaving these hoods went up the outside of the building to the roof. Another duct going up the side of the building was traced to an autoclave in a mechanical space across from room 105. In the Nightingale Building, the Psychology Department has hoods in rooms 316, 319, and 371. The hoods in rooms 316 and 319 share a common exhaust fan, with an estimated discharge volume of 760 cfm. The hood in room 371, with an opening of 28.5" x 12" rated at 100 fpm, has a discharge volume of 360 cfm.

E) The Hurtig Chemistry Building

The Hurtig Chemistry Building has 1 exhaust stack which is connected to 48 separate laboratory fume hoods and has a discharge volume of 79,615 CFM. This stack is 80" in diameter to achieve an exhaust velocity of 2,281 feet per minute. This stack discharges 34 feet above the roof of this building, at a height datum of 113'-5".

F) The Mugar Science Building

The Mugar Science Building has 2 separate exhaust stacks. One stack is connected to 39 separate laboratory fume hoods and has a discharge volume of 39,750 CFM. This stack is 60" in diameter culminating with a cone 56" in diameter, to achieve an exhaust velocity of 2,324 feet per minute. This stack discharges above the roof of this building at a height datum of 112'-6". The second stack is connected to 24 separate laboratory fume hoods and has a discharge volume of 24,000 CFM. This stack is 48" in diameter culminating with a cone 40" in diameter, to achieve an exhaust velocity of 2,750 feet per minute. This stack discharges above the roof of this building at a height datum of 106'-6".

G) The Forsyth Building

The Forsyth Building is listed as having hoods in room 010D, 015, 020A, 225C and 244D. The basement activities include the Plasma Science Lab, the Combustion Lab, and Thin Film Plating. These exhausts are more characterized as process exhausts rather than laboratory chemical fume hoods, where excess heat and dynamometer exhaust are being removed from the building. This building also houses the Health Services and a Childcare Center, which by their presence exerts a pressure not to permit the use of toxic or irritating chemicals in this location. In addition, releases from the roof of this building would be blocked by the Dana and Snell Engineering buildings from directly impacting the Engineering Science Center buildings. Therefore, emissions from the Forsyth Building are not explicitly included in this evaluation.

4.1 Achieving the Dilution Goal for Fume Hood Exhausts

The volatilization of 100 ml of liquid nitrobenzene in a fume hood represents the release of 2,008.3 milligrams per minute (mg/min). Converting this release rate expressed in units of mass to units of volume, at standard temperature and pressure conditions, leads to a quantity of 398.9 milliliters per minute (ml/min). That is, the liquid being evaporated expands in volume from 1.67 ml/min of liquid to 398.9 ml/min of vapor. Dividing this volume of pure nitrobenzene into the exhaust volume of a given stack yields the stack discharge concentration of the nitrobenzene. Achievement of the selected Dilution Goal of 1/250 of the TLV for nitrobenzene, or 0.004 ppm, at any nearby air intakes, the amount of dilution required of the stack effluent after it is discharged is therefore the stack concentration, in ppm, divided by the 0.004 ppm. These calculations, for a typical stack, one of the 14 stacks on the Snell Engineering Building with a discharge volumes of 890 cfm, are summarized in Table 4.1. As presented in this table, the discharge rate of 890 cubic feet per minute is converted to metric units to yield a value of 25.2 cubic meters per minute. Dividing the approximately 400 milliliters per minute of nitrobenzene vapors into this volume yields a concentration in the stack of 15.82 ppm. Dividing this stack concentration by the maximum acceptable concentration at a nearby air intake of 0.004 ppm yields the dilution requirement of 3,956 times.

Table 4.1 CALCULATION OF DILUTION REQUIREMENTS FOR 890 CFM STACK, SNELL ENGINEERING BUILDING

STACK VOLUME PARAMETERS	890	VOLUME, CFM
	9.0	DIAMETER, INCHES
	2,014.5	VELOCITY, FPM
COMPOUND	NITROBENZENE	
USAGE RATE	100	ml/hour (as liquid)
	1.67	ml/min, (as liquid)
Molecular wgt.	123.11	
SPEC. GRAVITY	1.205	gm/ml
	2,008.3	mg/min = source strength
	398.9	ml/min, (as vapor)
Exh. Volume	25.2	cubic meters/minute
Stack conc'n	15.8245	ppm
TLV/250	.0040	ppm

DILUTION REQUIRED = 3,956 TIMES

The results of this calculation are also presented in the first line of Table 4.2 which summarizes this relationship for the 39 stacks identified in this evaluation effort.

Table 4.2
SUMMARY OF STACK DISCHARGE PARAMETERS, BY BUILDING

BUILDING	STACKS/ROOMS		CFM	DIAM.	FT/MIN	STACK, PPM	DILUTION REQUIRED
SNELL ENG.	14	---	890	9"	2,015	15.82	3,956
	3	---	1,420	11"	2,152	9.92	2,480
	1	---	1,540	11"	2,334	9.14	2,286
	2	---	1,960	13"	2,126	7.18	1,796
DANA	1	336	4,500	19"	2,262	3.13	782
	1	346	4,000	12"	5,093	3.52	880
	1	348	4,500	12"	5,730	3.13	782
RICHARDS	1	434	980	9"	2,218	14.37	3,593
	1	453	630	8"	1,805	22.35	5,589
	1	455	890	9"	2,015	15.82	3,956
LAKE	1	117	670	8"	1,919	21.01	5,255
	1	118	360	6"	1,833	39.11	9,780
	1	119	760	8"	2,177	18.53	4,633

Table 4.2 (Continued)

SUMMARY OF STACK DISCHARGE PARAMETERS, BY BUILDING

NIGHTINGALE	1	316/319	760	8"	2,177	18.53	4,633
	1	371	360	6"	1,833	39.11	9,780
HURTIG	1	---	79,615	80"	2,281	.18	44
MUGAR	1	---	39,750	56"	2,324	.35	89
	1	---	24,000	40"	2,750	.59	147
FORSYTH	5	---	630	8"	1,805	22.35	5,589

Stacks = 39 >> 186,345 CFM

Table 4.2 lists 39 stacks with a total discharged volume of 186,345 cfm. In this table, for each of the buildings with identified laboratory fume hood exhausts, the number of stacks with a given discharge volume, from 360 cfm up to 79,615 cfm, are listed. Also included in this table are the stack diameter, the discharge velocity (in feet per minute), the stack concentration of nitrobenzene for the Dilution Goal release rate and, the dilution requirement to be achieved by wind dilution and stack height differential. The information presented in this table is reorganized by stack discharge volume and presented again in Table 4.3.

Table 4.3 lists the 39 identified stacks according to the 15 different air volumes they discharge. The determination of the stack height requirements for achieving the Dilution Requirements for these differing air volumes have been calculated based on the algorithms published by David Wilson in his paper, "A Design Procedure for Estimating Air Intake Contamination from Nearby Exhaust Vents". The results from this evaluation are presented in Figures 4.1, 4.2, and 4.3 for three categories of five stacks each: the five lowest volume exhausts, the five highest volume exhausts, and the remaining medium volume exhausts. The lowest volume exhausts are the 360, 630, 670, 760 and 890 cfm stacks, which are displayed in Figure 4.1. The medium volume exhausts are the 980, 1,420, 1,540, 1,960 and 4,000 cfm exhausts, which are displayed in Figure 4.2. The high volume exhausts include the two 4,500 stacks plus those discharging 24,000, 39,700 and 79,615 cfm, which are displayed in Figure 4.3. In each of these three figures the information presented is the HEIGHT DIFFERENCE REQUIRED, in FEET, for the stack top as compared with the air intake in order to achieve the Dilution Goal for a receptor at a given downwind distance.

Table 4.3
SUMMARY OF STACK DISCHARGE PARAMETERS, BY CFM

CFM	STACKS	DIAM.	FT/MIN	STACK, PPM	DILUTION REQUIRED
360	2	6"	1,833	39.11	9,780
630	6	8"	1,805	22.35	5,589
670	1	8"	1,919	21.01	5,255
760	2	8"	2,177	18.53	4,633
890	15	9"	2,015	15.82	3,956
980	1	9"	2,218	14.37	3,593
1,420	3	11"	2,152	9.92	2,480
1,540	1	11"	2,334	9.14	2,286
1,960	2	13"	2,126	7.18	1,796
4,000	1	12"	5,093	3.52	880
4,500	1	19"	2,262	3.13	782
4,500	1	12"	5,730	3.13	782
24,000	1	40"	2,750	.59	147
39,750	1	56"	2,324	.35	89
79,615	1	80"	2,281	.18	44

While it is the intent that all laboratory fume hoods should be able to provide the same amount of dilution for chemicals discharged to the atmosphere, this uniform degree of protection becomes impractical for a stack only discharging 360 cfm. This is because this initial volume provides very little initial dilution and so the requirement for wind and height based dilution becomes large. From a practical standpoint therefore, the Dilution Requirement for the four lowest categories of stacks is reduced by one half in this evaluation. This Dilution Goal is still conservative, requiring the achievement of the $^{1}/_{125}$ of the TLV for the nitrobenzene release as opposed to the achievement of $^{1}/_{250}$ of the TLV. Both of these goals still require a dilution of two orders of magnitude below the TLV. Part of the rationale were permitting this reduced Dilution Goal for these hoods is that, as detailed in Appendix A, their actual use for the disposal of chemicals to the atmosphere is very small. The specific hoods involved are those of the Psychology Department on the third floor of the Nightingale Building, those of the Biology Department on the first floor of the Lake Building, and those of the Engineering Departments in the Forsyth Buildings. It should be noted that the activities in the Forsyth Building reflect the fact that both the University's Health Services and Day Care facility are located in this building, creating a limitation on the level of chemical usage. The stack height requirements for this reduced Dilution Goal are presented in Figure 4.4.

For each of these stack height determinations, there a downwind distance beyond which the Dilution Goal is achieved merely by wind induced dilution and therefore no stack height differential is required. For distances less than this, there remains a Potential Impact Area for which a specific determination needs to made as to the adequacy of the stack height differential being provided. Figure 4.5 presents a view of the Northeastern Campus where each stack has its Potential Impact Area shaded. The information presented in this figure assumes that all stacks will have a minimum of 10 feet of height above nearby air intakes. If the stacks are a minimum of 26 feet above all air intakes, then the shaded area of Potential Impact is reduced, as shown in Figure 4.6.

Since the distance between the stacks on the Snell Engineering building vary from 122' to 134' to the near face of the planned Engineering Science Center and from 206' to 218' to the far, south, side of the building. These source to receptor distances are displayed in Figure 4.1. Reviewing this figure indicates that the stack height requirements for achieving the Dilution Goal are in the range of 29 to 18 feet, as summarized in Table 4.2.

Table 4.3 Summary of Height Differences Required

	HEIGHT DIFFERENCE REQUIRED, Feet Stack Top Above Air Intake	
STACK	Near (North) Side	Far (South) Side
890 cfm	23 Feet	29 Feet
1,420 cfm	20 Feet	23 Feet
1,960 cfm	18 Feet	20 Feet

Since the planned height difference between the top of the stacks on the Snell Engineering Building and the air intakes on the sidewall of the penthouse mechanical room is 34 feet, based on the information provided. This relationship is presented in Figure 4.7. All of these geometries, with air intakes on either side of the penthouse mechanical room, would achieve the Dilution Goal. Any upward changes in the location of the proposed air intakes for this building would require a reevaluation.

4.2 Discussion of Non-Fume Hood Sources

In addition to the evaluation of potential impacts from laboratory fume hood exhausts, this micrometeorological evaluation also considered the generation of air contaminants from the Ruggles MBTA Station and the Northeastern University parking garage and power plant stack.

G & H) The Ruggles MBTA Station and Northeastern Parking Garage

Both the Ruggles MBTA Station and the Northeastern Parking Garage represent sources of air contaminants which arise from the operation of motor vehicles which are distributed over an area, as opposed to the laboratory fume hood exhausts, which are point sources with significant initial vertical momentum. These two sources of air contaminants are therefore analyzed differently than the fume hood exhausts are. As area sources, the concentrations of air contaminants decrease uniformly as a function of distance and elevation

5.0 New Stack Evaluation

The design specifications for the planned Engineering Science Center indicate 4 floors of laboratory space, with 20 laboratories per floor and two fume hoods per laboratory. This represents a total of 160 laboratory fume hoods. At 680 cfm of exhaust air per hood, this represents an total exhaust air volume of 108,800 cfm. In consideration of the fact that there are four vertical mechanical shaft in the initial design drawings, the logical number of stacks should therefore be divisible by four. Recognizing the advantages of the combining the effluent of several fume hoods into one system, as demonstrated for the Mugar and Hurtig buildings, the stack configurations evaluated are therefore:

Option #1: 4 stacks of 27,200 cfm each (40 hoods/stack),
Option #2: 8 stacks of 13,600 cfm each (20 hoods/stack),
Option #3: 16 stacks of 6,800 cfm each (10 hoods/stack), or
Option #4: 32 stacks of 3,400 cfm each (5 hoods/stack).

A comparison of the stack height requirements for achieving the Dilution Goal, involving the release of nitrobenzene, are presented for these four stack options in Figure 5.1. The characteristics of these stack height curves can be summarized as follows:

Option #1: For a stack discharging 27,200 cfm, discharging the combined effluent from 40 hoods, its maximum height requirement would be for a very close receptor, on the order of less than 30 feet; the stack would need to be at least 12' higher than this air intake. For greater distances away, the stack height differential decreases smoothly until, for receptors greater than 105' away, the required dilution is calculated to be achieved merely by wind-induced dilution and no height differential is required.

Option #2: For a stack discharging 13,600 cfm, discharging the combined effluent from 20 hoods, its maximum height requirement would also be for receptors only about 30' away; this time however,

the stack would need to be 10' higher than the air intake. For greater distances away, the stack height differential decreases until, for receptors greater than 155' away, the required dilution is calculated to be achieved merely by wind-induced dilution and no height differential is required.

Option #3: For a stack discharging 6,800 cfm, discharging the combined effluent from 10 hoods, its maximum height requirement occurs for receptors about 100' away; the stack would need to be 10' higher than an air intake at that distance away. For greater distances away, the stack height differential decreases until, for receptors greater than 230' away, the required dilution is calculated to be achieved merely by wind-induced dilution and no height differential is required.

Option #4: For a stack discharging 3,400 cfm, discharging the combined effluent from 5 hoods, its maximum height requirement occurs for receptors about 150' away; the stack would need to be 15' higher than any air intakes at that location. For greater distances away, the stack height differential decreases until, for receptors greater than 290' away, the required dilution is calculated to be achieved by a stack height differential of only 6'.

The selection among these options, in terms of minimum reentrainment potential, is a function of the distances to the nearby air intakes. There are of course other considerations, such as structural and duct sizing constraints, that need to be included in this selection process. The distance to the nearby air intakes will be a function of the specific locations selected for the stacks. Ranges of maximum and minimum distances from these stacks to nearby air intakes can however, be established.

Assuming that the exhaust stacks will be located above the penthouse roof near where the vertical risers are in the building, in order to facilitate the minimum lengths of ductwork to connect with the hoods, the zones of influence for these potential locations can determined. Figure 5.2 presented to locus of points at distances of 50', 150' and 250' from these probable stack locations. Recognizing that the 250' radius extends to air intakes on the north side of the Snell Engineering Building and that the center of the air intakes on this building are about 10' above the height of the penthouse roof of the Engineering Science Center (see Figure 5.3), it should be clear that there would be no benefit to the Option #3 or Option #4 configurations. Recognizing the air intakes for this building will be centered approximately eight feet below the level of the penthouse roof of the Engineering Science Center, a stack height of ten (10) feet would exceed to 13' or 10' minimum stack height differential for Option #1 and Option #2 respectively.

APPENDIX TO DRAFT REPORT

MICROMETEOROLOGY AND REENTRAINMENT EVALUATION FOR THE PLANNED ENGINEERING SCIENCE CENTER AT NORTHEASTERN UNIVERSITY

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1.0 Introduction

This document summarizes the specifics of the chemical use analysis as part of the effort to make the following two determinations for the planned Engineering Science Center:

1) The optimum air intake location, and
2) The optimum stack configuration, location and minimum height requirements.

The air intake evaluation is based on determinations of the potential impacts of air contaminants from the following nearby sources:

A) Laboratory Exhausts of the Snell Engineering Building,
B) Laboratory Exhausts of the Dana Physics Building,
C) Laboratory Exhausts of the Richards Building,
D) Laboratory Exhausts of the United Realty Complex: Lake, Holmes, & Nightingale Buildings,
E) Laboratory Exhausts of the Mugar Science Building
F) Laboratory Exhausts of the Hurtig Chemistry Building
G) Bus Exhausts at the Ruggles MBTA Station
H) Vehicle Exhausts at the Northeastern Parking Garage

The stack evaluation is based on determinations of the potential impacts on the air intakes of the following nearby buildings:

A) The Snell Engineering Building,
B) The Dana Physics Building,
C) The Library Resource Center,
D) The Ell Student Center,
E) The Hayden Building,
F) The Churchill Building,
G) The Forsyth Building,
H) The Northeastern Parking Garage
I) An Office Building Built on Parcel 18

This report is organized so as to first present a section on the evaluation procedure followed by descriptions of the emission characteristics and expected site impact for each the above identified sources. This is followed by a section of the evaluation of the planned new stacks of the Engineering Science Building on the nearby air intakes.

2.0 Evaluation Technique

This evaluation of micro-meteorology and reentrainment assessment builds on the work previously done by Life Energy Associates to determine the stack height requirements for both the Mugar Science Building and the Hurtig Chemistry Building. In both of these previous studies the analysis of dilution requirements was based on the discharge resulting from the evaporation of 100 milliliters of liquid nitrobenzene from a laboratory fume hood over an interval of one hour. Nitrobenzene was selected as the "worst case" indicator chemical because it is highly irritating, has a very low odor recognition threshold and is a commonly used solvent. The selection of nitrobenzene was also based on the fact that it had the lowest occupational Threshold Limit Value (TLV) of the chemicals identified as being in common usage in these labs. This determination of the chemical usage in both the Mugar and Hurtig Buildings was accomplished through discussions with Mr. Steven Larson, the then University Health and Safety Officer. For the Mugar evaluation, there had been a review of the purchase requisitions for chemicals by the principal research chemists using these facilities. The monthly usage rates indicated were typically for liter quantities of solvents and gram quantities of reactant chemicals. Based on the successful results of the stack height determinations performed for the Mugar Science Building and the Hurtig Chemistry Building, the Dilution Goal selected for this current study is to achieve, for this release rate of nitrobenzene, a maximum of only $^1/_{150}$ of the TLV of 1 ppm for nitrobenzene at any nearby air intakes.

In this study, because of a concern that chemical usage for the non-chemistry, engineering disciplines would be considerably different than that determined for the Mugar and Hurtig buildings, a survey of Chemical Hygiene Officers, as identified by Mr. Jack Price, the current University Health and Safety Officer, was also performed to determine their opinions as to the chemical usage in the laboratory fumes hoods in the Snell Engineering building, the Dana Physics building, and the Forsyth building, as well as the Nightingale, Holmes and Lake Building components of the United Realty complex. The conclusion of this review of current and anticipated discharges of chemicals, to the atmosphere via laboratory fume hoods, is that the selection of the 100 ml nitrobenzene still represents a "worst case" example. Typically the actual release rates for chemicals are 10 ml or less and over longer intervals of time.

It should also be noted that this analysis technique is only appropriate for chemicals for which dilution is an acceptable form of disposal. For the disposal of chemicals such as muta-

gens, carcinogens and teratogens or other highly toxic substances for which there are no safe levels of exposures, fume hoods without additional pollution controls should not be used. Experiments requiring these zero exposure chemicals should be restricted to use in glove boxes with their own individual pollution control systems. The decision upon which this determination can be made, on a chemical by chemical basis, has to be based on the best available information at that time.

3.0 Source Characterizations

The section summarizes the specific information on the characteristics for each of the identified sources. For the buildings with laboratory fume hoods, this characterization includes a description of the fume hoods and a determination of the stack height requirements necessary to achieve the Dilution Goal developed in Section 2.0 of this report. For the other sources, a similar characterization of source strength and dilution description is also presented.

A) The Snell Engineering Building

The Snell Engineering Building has 20 separate exhaust stacks connected to 20 separate laboratory fume hoods. Information on the current and expected future levels of chemical emissions was obtained from Professor Ron Willey (x-3962), Chemical Hygiene Officer for the Chemical Engineering Department. He reported minimal chemical usage in the hoods in Snell 302, 306, 404, 456, and 487. The usage he mentioned was the occasional use of acetic acid in liquid-liquid extractions. He also mentioned the possibility that flue gas scrubber experiments of Professor Levendis (x-3806), currently being performed in the Forsyth Building, room 244, might be relocated to Snell in the future. This experiment involves the release of milligram quantities of SO_2 and NO_x over several hours.

These stacks discharge above the penthouse of this building at a height datum of 97'-6". The exhaust volumes for this systems vary from 890 cfm for 14 of the systems up to 1,960 cfm for two of the systems. The specifics of these Fume Exhaust Fans (FEFs) are summarized in Table 3.1.

For the volatilization of 100 ml of liquid nitrobenzene in a fume hood, this represents the release of 2,008.3 milligrams per minute (mg/min) of source strength. Converting this release in units of mass to units of volume, at standard temperature and

pressure conditions, equals 398.9 milliliters per minute (ml/-min).

Table 3.1 Exhaust Fans for the Snell Engineering Building

890 CFM,	14 Units,	FEF: 1, 2, 3, 4, 7, 8, 10, 13, 14, 17, 18, 19 & 20.
1,420 CFM,	3 Units,	FEF: 6, 15 & 16.
1,540 CFM	1 Unit,	FEF: 9
1,960 CFM	2 Units,	FEF: 11 & 12

Total = 22,090 CFM

That is, the liquid being evaporated expands in volume from 1.67 ml/min of liquid to 398.9 ml/min of vapor. Dividing this volume of pure nitrobenzene into the 890 cfm (25.2 cubic meters per minute) of exhaust air volume yields a stack discharge concentration of 15.82 ppm of nitrobenzene. To achieve the selected Dilution Goal of $^{1}/_{250}$ of the TLV for nitrobenzene, or 0.004 ppm, at any nearby air intakes, the amount of dilution required of the stack effluent after it is discharged is therefore 3,956 times. These calculations for the 890 cfm stacks are summarized in Table 3.2.

Table 3.2 CALCULATION OF DILUTION REQUIREMENTS FOR SNELL ENGINEERING BUILDING

STACK PARAMETERS	890	VOLUME, CFM
	9.0	DIAMETER, INCHES
	2,014.5	VELOCITY, FPM
COMPOUND	NITROBENZENE	
USAGE RATE	100	ml/hour (as liquid)
	1.67	ml/min, (as liquid)
Molecular wgt.	123.11	
SPEC. GRAVITY	1.205	gm/ml
	2,008.3	mg/min = source strength
	398.9	ml/min, (as vapor)
Exh. Volume	25.2	cubic meters/minute
Stack conc'n	15.8245	ppm
TLV/250	.0040	ppm

DILUTION REQUIRED = 3,956 TIMES

For the other exhaust volumes for the stacks on the Snell Engineering Building, 1,420 and 1,960 cfm respectively, since the volume of exhaust air is increased, the concentration in the stack is reduced and the amount of dilution required between the stack and nearby air intakes are similarly reduced. These calculations are summarized in Tables 3.3 and 3.4.

Table 3.3 Summary of Dilution Requirements for 1,420 CFM Stacks on Snell Engineering Building

STACK	1,420	VOLUME, CFM
PARAMETERS	11.0	DIAMETER, INCHES
	2,151.7	VELOCITY, FPM
NITROBENZENE	398.9	ml/min = source strength
Exh. Volume	40.2	cubic meters/minute
Stack conc'n	9.9182	ppm
TLV/250	.0040	ppm

DILUTION REQUIRED = 2,480 TIMES

Table 3.4 Summary of Dilution Requirements for 1,960 CFM Stacks on Snell Engineering Building

STACK	1,960	VOLUME, CFM
PARAMETERS	13.0	DIAMETER, INCHES
	2,126.4	VELOCITY, FPM
NITROBENZENE	398.9	ml/min = source strength
Exh. Volume	55.5	cubic meters/minute
Stack conc'n	7.1856	ppm
TLV/250	.0040	ppm

DILUTION REQUIRED = 1,796 TIMES

The stack height requirements for achieving these Dilution Requirements have been calculated based on the algorithms published by David Wilson in his paper, "A Design Procedure for Estimating Air Intake Contamination from Nearby Exhaust Vents". The results from this evaluation are presented in Figure 3.1. Since the distance between the stacks on the Snell Engineering building vary from 122' to 134' to the near face of the planned Engineering Science Center and from 206' to 218' to the far, south, side of the building. These source to receptor distances are highlighted in Figure 3.1. Reviewing this figure indicates

that the stack height requirements for achieving the Dilution Goal are in the range of 29 to 18 feet, as summarized in Table 3.5.

Table 3.5 Summary of Height Differences Required

	HEIGHT DIFFERENCE REQUIRED, Feet Stack Top Above Air Intake	
STACK	Near (North) Side	Far (South) Side
890 cfm	23 Feet	29 Feet
1,420 cfm	20 Feet	23 Feet
1,960 cfm	18 Feet	20 Feet

Since the planned height difference between the top of the stacks on the Snell Engineering Building and the air intakes on the sidewall of the penthouse mechanical room is 34 feet, based on the information provided. All of these geometries, with air intakes on either side of the penthouse mechanical room, would achieve the Dilution Goal. Any upward changes in the location of the proposed air intakes for this building would require a reevaluation.

B) The Dana Physics Building

The Dana Physics Building is the home to the Semiconductor Processing Laboratory, which is located in rooms 336, 346, 348. According to information provided by Mr. Keith Warner, Semiconductor Process Engineer, the following is a summary of the chemicals exhausted to the atmosphere from these locations.

In room 336 there are four hoods connected to one exhaust system. The stack itself has the dimensions, which is equivalent in area to a 19.1" diameter stack. In these hoods, in addition to the storage of several acids, involve the release of silicon tetrafluoride in an amount that would result in a concentration of 13 ppb (0.0126 ppm) in the stack. There is, however, no established TLV for this gas. To dilute this concentration down to the 4 ppb (0.004 ppm) concentration required for the nitrobenzene case would require wind induced dilution of only three times. The specifics of this calculation are summarized in Table 3.6.

Table 3.6
CALCULATION OF DILUTION REQUIREMENTS FOR DANA STACKS

DANA 336	4,500	VOLUME, CFM
PARAMETERS	19.1	DIAMETER, INCHES (Equivalent)
	2,256.9	VELOCITY, FPM
Silicon Tetrafluoride	1.6	ml/min = source strength
Exh. Volume	127.4	cubic meters/minute
Stack conc'n	.0126	ppm
Goal = TLV/250	.0040	ppm
DILUTION REQUIRED	3	TIMES

==

DANA 346	4,000	VOLUME, CFM
PARAMETERS	12.0	DIAMETER, INCHES
	5,093.0	VELOCITY, FPM
NITROBENZENE	.5	ml/min = source strength
Exh. Volume	113.3	cubic meters/minute
Stack conc'n	.0044	ppm
Goal = TLV/250	.0002	ppm
DILUTION REQUIRED	22	TIMES

==

DANA 348	4,500	VOLUME, CFM
PARAMETERS	12.0	DIAMETER, INCHES
	5,729.6	VELOCITY, FPM
HCl (Normal Condition)		
Exh. Volume	127.4	cubic meters/minute
Stack conc'n	3.2000	ppm
Goal = TLV/250	.0200	ppm
DILUTION REQUIRED	160	TIMES
HYDRAZINE (Upset Condition)		
Stack conc'n	13.3000	ppm
Goal = TLV/250	.0004	ppm
DILUTION REQUIRED	33,250	TIMES

==

C) The Richards Building

The Richards Building has been identified as having 9 laboratory fume hoods. It has been reported that rooms 412 and 503 each have two hoods in them and rooms: 426, 434, 453, 455, and 459

each have one hood in them. An inspection of the area determined the following information. The hoods in rooms 426 and 503 are not currently in use. The hood in room 434, according to Dr. Wendy Smith uses ether in ml per week quantities and toluene and chloroform in ml per month quantities. This hood at 50" by 28" is estimated to discharge 980 cfm. The hoods in rooms 453 and 455 were reported to use ml quantities of xylene, formaldehyde, ethyl alcohol and ammonium sulfide. This hood in room 453, at 50.25" by 18", is estimated to discharge 630 cfm. The hood in room 455, at 50.5" by 25:25", is estimated to discharge 890 cfm.

D) The United Realty Building Complex: Lake, Holmes, & Nightingale

In the Lake Building, rooms 117, 118, and 119 were determined to have laboratory fume hoods used by the Biology Department. The hood in room 117, at 50.5" by 19" is estimated to discharge 670 cfm. The hood in room 118, at 30" by $17\frac{3}{8}$", is estimated to discharge 360 cfm. The hood in room 119, at 47.25" by 23.5", is estimated to discharge 760 cfm. The ductwork leaving these hoods went up the outside of the building to the roof. Another duct going up the side of the building was traced to an autoclave in a mechanical space across from room 105.

In the Holmes Building, the Biology Department has two hoods, one in room 214 and the other in 216. The fume hood in room 214 has an open face area of about 9 ft^2, while the one in room is about 6.25 ft^2. Multiplying these areas by a face velocity of 100 fpm, the two hoods can be estimated as having exhaust volumes of 900 and 625 cfm, for a total of 1525 cfm. These air volumes are added together because the hoods themselves are ducted together, with a single stack on the roof of Lake Hall. According to information in a letter of February 23, 1992 from Gwilym S. Jones, PhD, Professor of Biology and Director, these hoods are used primarily for drying vertebrate specimens (i.e. air-drying specimens on bones, so that they may be further processed. In terms of chemical emissions, they would involve formaldehyde and ammonia which are transferred from one container to another in the hood in room 214. The duration of these transfers is only for a couple of minutes, at most, and the frequency of this activity is no more often then once per week and generally about once per month.

In the Nightingale Building, the Psychology Department has hoods in rooms 316, 319, and 371. The hoods in rooms 316 and 319 share a common exhaust fan, with an estimated discharge volume of 760 cfm. The hood in room 371, with an opening of 28.5" x 12" rated at 100 fpm, has a discharge volume of 360 cfm.

E) The Hurtig Chemistry Building

The Hurtig Chemistry Building has 1 exhaust stack which is connected to 48 separate laboratory fume hoods and has a discharge volume of 79,615 CFM. This stack is 80" in diameter to achieve an exhaust velocity of 2,281 feet per minute. This stack discharges 34 feet above the roof of this building, at a height datum of 113'-5". The specifics of the Hood Exhaust Fans (HEFs) connected to this stack are summarized in Table 3.7.

Table 3.7 SUMMARY OF HURTIG HOOD EXHAUST FANS

FAN	CFM	FAN	CFM
HEF - 1	1,588	HEF - 25	2,113
HEF - 2	1,575	HEF - 26	1,750
HEF - 3	1,050	HEF - 27	2,625
HEF - 4	1,050	HEF - 28	875
HEF - 5	525	HEF - 29	3,500
HEF - 6	1,050	HEF - 30	875
HEF - 7	525	HEF - 31	1,750
HEF - 8	1,825	HEF - 32	3,500
HEF - 9	525	HEF - 33	1,000
HEF - 10	1,575	HEF - 34	1,750
HEF - 11	1,050	HEF - 35	1,750
HEF - 12	2,113	HEF - 36	1,750
HEF - 13	2,113	HEF - 37	1,750
HEF - 14	1,050	HEF - 38	3,500
HEF - 15	1,575	HEF - 39	1,750
HEF - 16	1,750	HEF - 40	1,750
HEF - 17	1,050	HEF - 41	2,625
HEF - 18	1,050	HEF - 42	2,625
HEF - 19	525	HEF - 43	1,750
HEF - 20	1,050	HEF - 44	1,750
HEF - 21	1,050	HEF - 45	2,625
HEF - 22	1,050	HEF - 46	1,750
HEF - 23	1,575	HEF - 47	3,500
HEF - 24	1,575	HEF - 49	1,138
	29,864		49,751

Total = 79,615 CFM

F) The Mugar Science Building

The Mugar Science Building has 2 separate exhaust stacks. One stack is connected to 39 separate laboratory fume hoods and has a discharge volume of 39,750 CFM. This stack is 60" in diameter culminating with a cone 56" in diameter, to achieve an exhaust velocity of 2,324 feet per minute. This stack discharges above the roof of this building at a height datum of 112'-6". The second stack is connected to 24 separate laboratory fume hoods and has a discharge volume of 24,000 CFM. This stack is 48" in diameter culminating with a cone 40" in diameter, to achieve an exhaust velocity of 2,750 feet per minute. This stack discharges above the roof of this building at a height datum of 106'-6". The specifics of the Hood Exhaust Fans (HEFs) connected to these two stacks are summarized in Table 3.8. with their dilution requirements presented in Table 3.9.

Table 3.8 SUMMARY OF MUGAR HOOD EXHAUST FANS

48" DIAMETER STACK			60" DIAMETER STACK		
FAN	ROOM	CFM	FAN	ROOM	CFM
F 1	19	1,000	F 3	131	1,000
F 2	213	1,000	F 4	304	1,000
F 9	111	1,000	F 5	7	750
F 18	212	1,000	F 6	108	1,000
F 19	212	1,000	F 7	107	1,000
F 20	212	1,000	F 11	118	1,000
F 21	212B	1,000	F 12	31	1,000
F 22	213	1,000	F 13	208	1,000
F 23	214	1,000	F 14	204	1,000
F 24	214	1,000	F 15	208	1,000
F 25	214	1,000	F 16	207	1,000
F 26	214	1,000	F 17	209	1,000
F 27	215	1,000	F 31	309	1,000
F 28	215	1,000	F 32	309	1,000
F 29	215	1,000	F 33	309	1,000
F 30	215	1,000	F 35	310	1,000
F 37	313	1,000	F 36	310B	1,000
F 38	314	1,000	F 42	320	1,000
F 39	314A	1,000	F 43	322	1,000
F 40	315	1,000	F 44	322A	1,000
F 41	316	1,000	F 45	GENERAL	1,000
F 53	415	1,000	F 46	322&323	1,000
F 56	24	1,000	F 47	333	1,000
F 81	14	1,000	F 48	334	1,000
			F 50	402	1,000
24 HOODS		24,000			

Completion of Fume Hood Listing for Mugar 60" Stack

F 51	403	1,000	F 52	406	1,000
F 54	431	1,000	F 55	433	1,000
F 58	208	1,000	F 59	208	1,000
F 60	24	1,000	F 61	408	1,000
F 62	24	1,000	F 63	409	1,000
F 64	11	1,000	F 65	119	1,000
F 66	16A&16B	2,000	F 67	410C	1,000
			39 HOODS		39,750

Table. 3.9 Summary of Dilution Requirements for 39,750 and 24,000 CFM Stacks on Mugar Science Building

STACK	39,750	VOLUME, CFM
PARAMETERS	56.0	DIAMETER, INCHES
	2,324.0	VELOCITY, FPM
NITROBENZENE	398.9	ml/min = source strength
Exh. Volume	1,125.7	cubic meters/minute
Stack conc'n	0.3543	ppm
TLV/250	.0040	ppm
DILUTION REQUIRED	= [illegible].5	TIMES

STACK	24,000	VOLUME, CFM
PARAMETERS	40.0	DIAMETER, INCHES
	2,750.2	VELOCITY, FPM
NITROBENZENE	398.9	ml/min = source strength
Exh. Volume	679.7	cubic meters/minute
Stack conc'n	0.586[illegible]	ppm
TLV/250	.0040	ppm
DILUTION REQUIRED	= 147	TIMES

G) The Forsyth Building

The Forsyth Building is listed as having hoods in room 010D, 015, 020A, 225C and 244D. The basement activities include the Plasma Science Lab, the Combustion Lab, and Thin Film Plating. These exhausts are more characterized as process exhausts rather than laboratory chemical fume hoods, where excess heat and dynamometer exhaust are being removed from the building. This building also houses the Health Services and a Childcare Center, which by their presence exerts a pressure not to permit the use of toxic or

irritating chemicals in this location. In addition, releases from the roof of this building would be blocked by the Dana and Snell Engineering buildings from directly impacting the Engineering Science Center buildings. Therefore, emissions from the Forsyth Building are not explicitly included in this evaluation.

H. The Ruggles MBTA Station

Both the Ruggles MBTA Station and the Northeastern Parking Garage represent sources of air contaminants which arise from the operation of motor vehicles which are distributed over an area, as opposed to the laboratory fume hood exhausts, which are point sources with significant initial vertical momentum. These two sources of air contaminants are therefore analyzed differently than the fume hood exhausts are. As area sources, the concentrations of air contaminants decrease uniformly as a function of distance.

A description of this facility was presented in the FINAL ENVIRONMENTAL IMPACT STATEMENT for the ORANGE LINE RELOCATION AND ARTERIAL STREET CONSTRUCTION, (SOUTHWEST CORRIDOR PROJECT) SOUTH COVE TO FOREST HILLS, BOSTON, MASSACHUSETTS (March, 1978 in Section 4.4.12.3), which predicted that:

> The Ruggles Street Station would be a major modal-change facility serving both proposed and future transportation modes. It would accommodate the proposed Orange Line Transit and Commuter Rail Lines, and serve local buses, vehicles from local streets and the proposed arterial street. Particular emphasis has been placed on the facility as a major local bus terminus. Further it would accommodate a proposed cross-town grade separated transit link in the future. The station site is located within the Roxbury district of the corridor, an area subject to the most extensive development in the future. In this capacity, the station has been designed to support the efficient transfer of a large number of anticipated passengers and vehicles, and to allow future joint development.
>
> The station configuration is essentially a pedestrian island, surrounded by the necessary vehicle loops and bus berths. A sufficient pedestrian plaza and cover would be provided to maintain clear movement and transfer in all weather conditions. The station area would be a major bus terminus with transfer and layover capabilities. Waiting vehicles would be accommodated on the perimeter of the pedestrian plaza. Buses would be provided with special berths for the transfer of passengers and the layover of appointed bus routes.

This prediction has come to pass, with this station providing connections to thirteen bus routes: 8, 8A, 15, 19, 22, 23, 28, 42, 43, 44, 45 and 47. Many of these routes have arrivals and departures of every ten or minutes or less. Based on a review of their individual schedules, weekday mornings between 8:30 a.m. and 9:30 a.m. should see the arrival or departure of 139 buses. Over this time interval, this represents the movement of 2.3 buses per minute. The emissions from urban buses include carbon monoxide, hydrocarbons, NOx, particulate matter. Without the benefit of stacks, the dilution of these air contaminants will be a function of distance and elevation. The greater the distance achieved from the source, the greater the amount of dilution achieved. It is therefore recommended that the air intakes on the planned ESC Building be located only on the northside of the mechanical penthouse, with no intakes on the south side overlooking the railroad tracks.

I) The Northeastern Parking Garage

Like the Ruggles MBTA Station, the air contaminants generated from this source are from motor vehicle exhaust, which include carbon monoxide, hydrocarbons, NOx, particulate matter. Like the case with the Ruggles MBTA Station, these emissions are an area source where the dilution of these air contaminants will be a function of distance and elevation. The greater the distance achieved from the source, the greater the amount of dilution achieved. It is therefore recommended that the air intakes on the planned ESC Building be located only on the northside of the mechanical penthouse, with no intakes on the south side

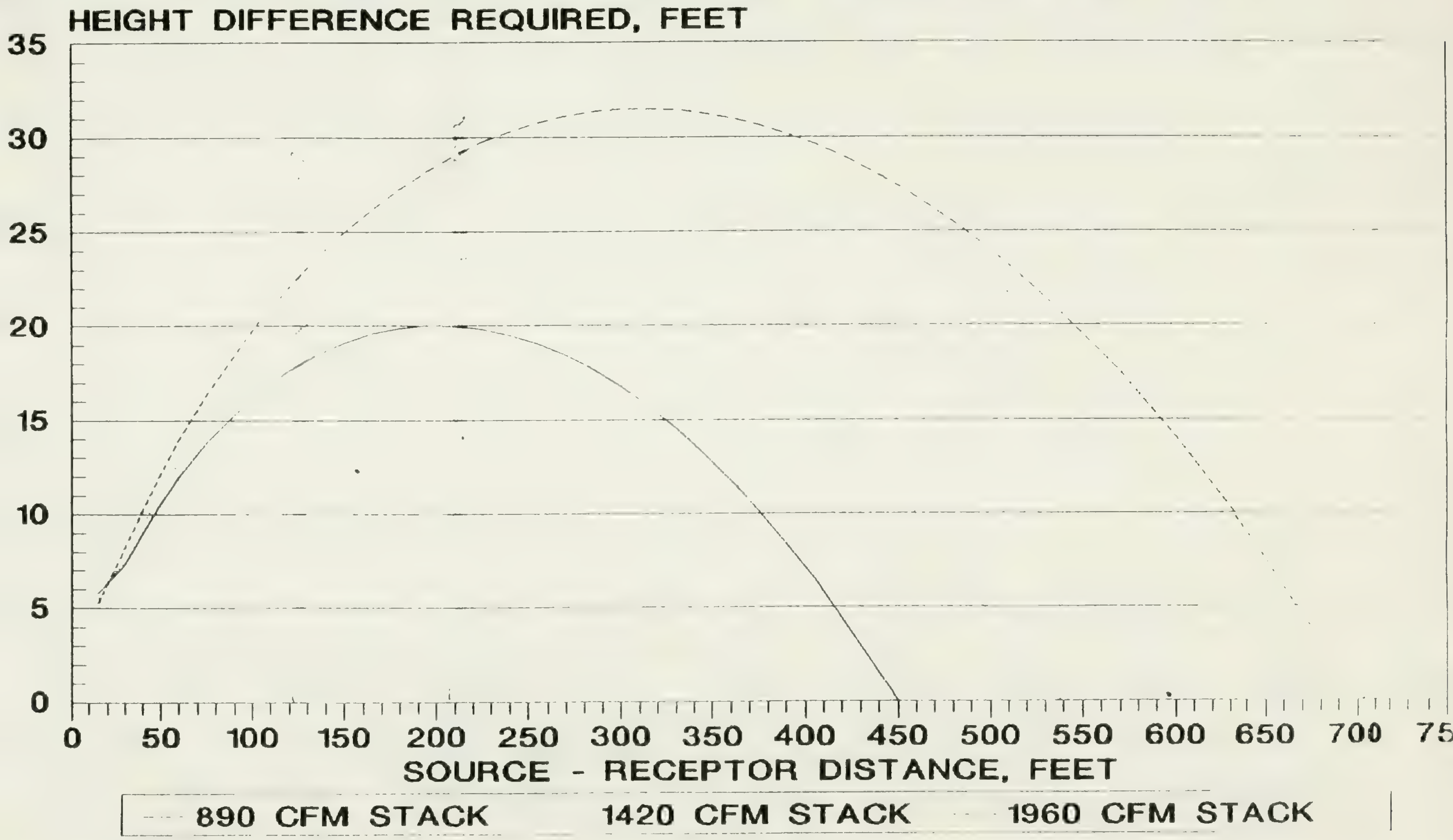
J) The Northeastern Power Plant Stack

The operation of the Northeastern University Power Plant are reported to be under review by the Massachusetts Department of Environmental Protection. This review is reported to be addressing the permitted fuel mix of sulfur-containing oil and natural gas, as well as the discharge velocity at the top of the stack. It is anticipated, within the scope of this investigation, that the achievement of the DEP requirements will provide a sufficient degree of protection for the any configuration of air intakes under consideration for the ESC Building.

FIGURE 3.1

STACK HEIGHT REQUIREMENTS, SNELL ENGINEERING BUILDING

THREE EXHAUST VOLUMES: 890, 1,420 & 1960 CFM



SNELL 02 01/27/92

FIGURE 4.1

STACK HEIGHT REQUIREMENTS FOR LOW VOLUME EXHAUSTS
STACK VOLUMES EQUALING 360, 630, 670, 760 & 890 CFM

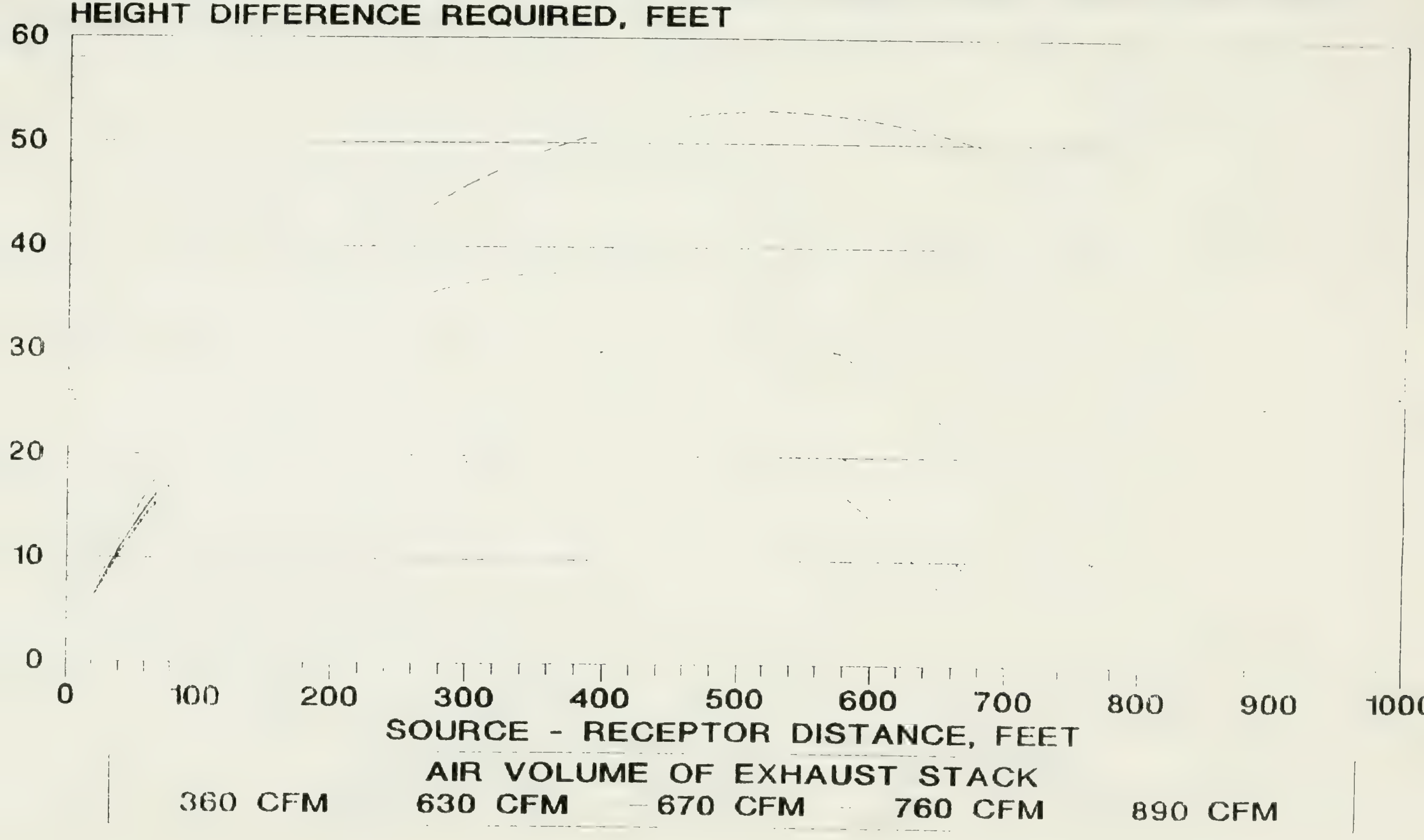


FIGURE 4.2

STACK HEIGHT REQUIREMENTS FOR MEDIUM VOLUME EXHAUSTS
STACK VOLUMES OF 980, 1,420, 1,540, 1,960 & 4,000 CFM

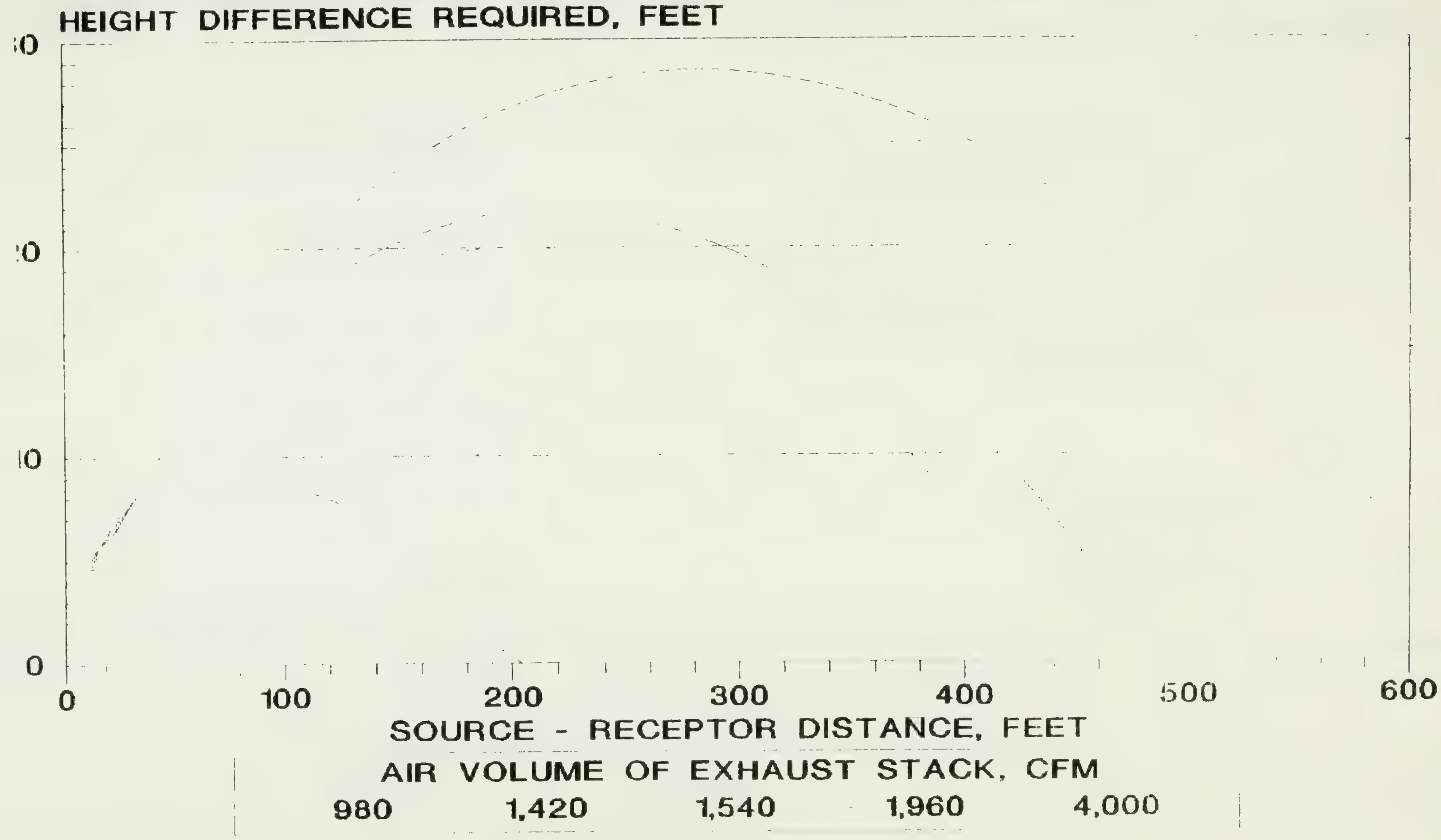


FIGURE 4.5

STACK HEIGHT REQUIREMENTS FOR HIGH VOLUME EXHAUSTS
STACK VOLUMES OF 4,500, 24,000, 39,750, & 79,615 CFM

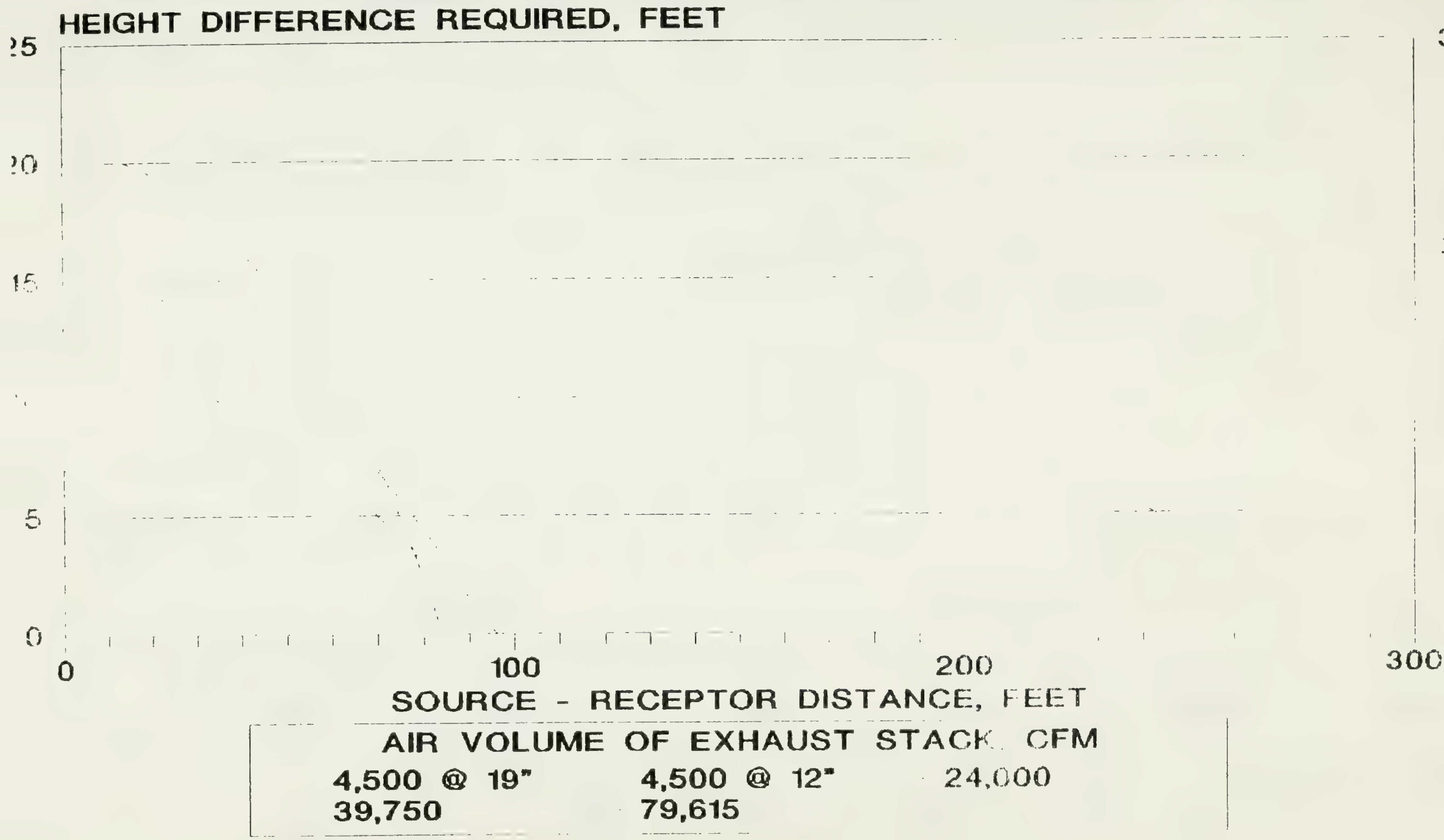
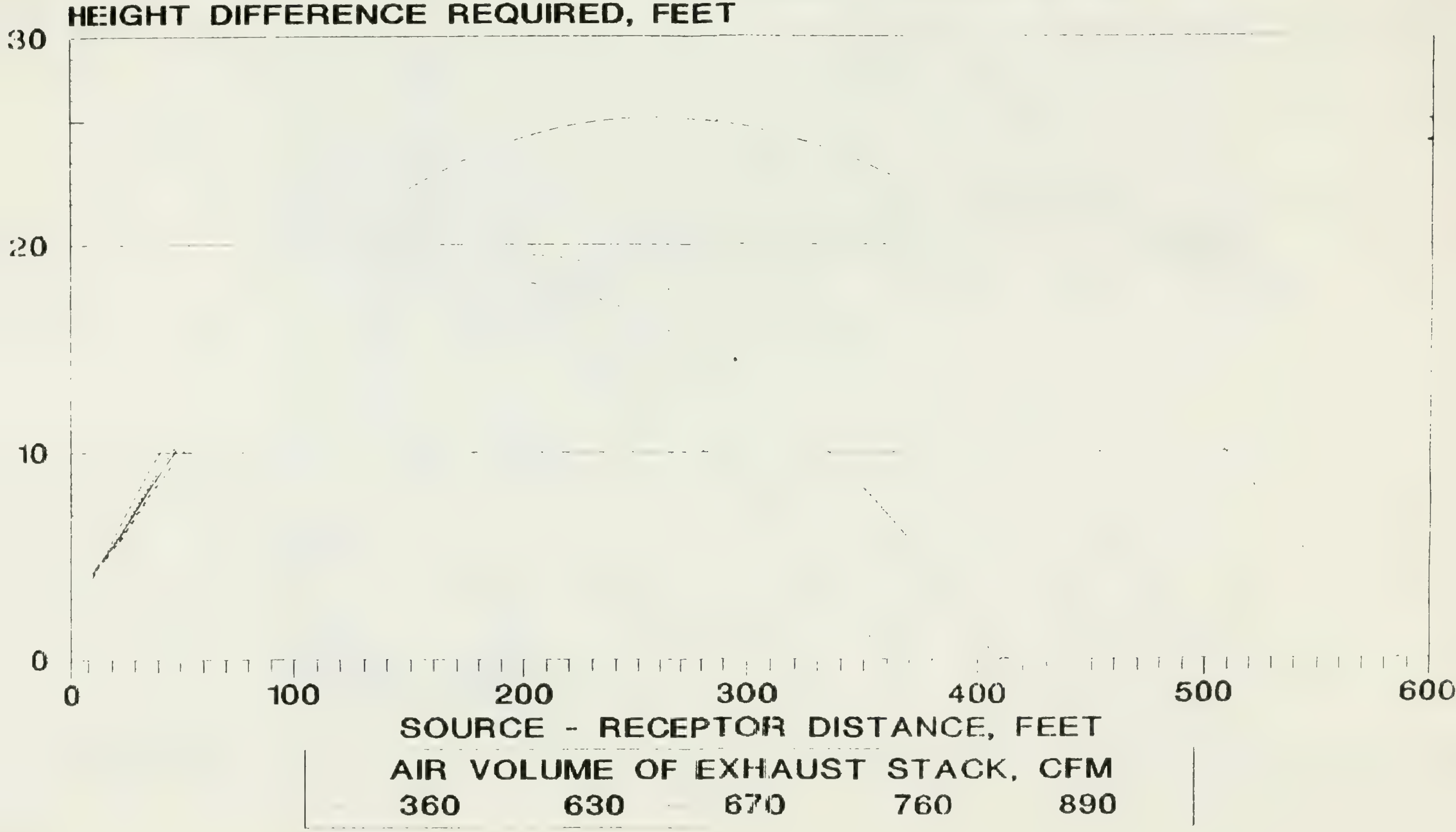


FIGURE 4.4

REDUCED STACK HEIGHT REQUIREMENTS, TLV/125 FOR LOW VOLUME EXHAUSTS



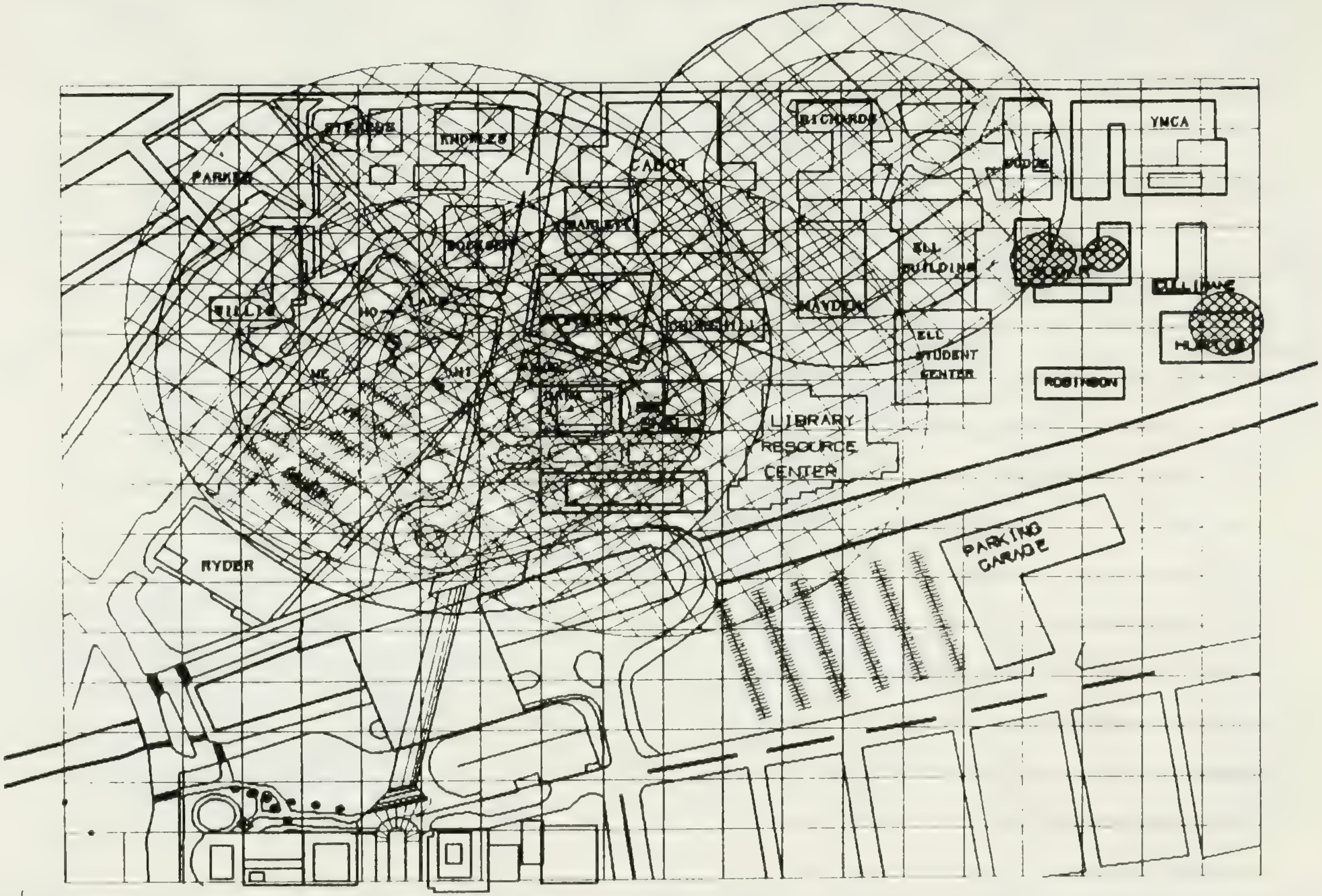


FIGURE 4.5
ZONES OF IMPACT FOR 10 FOOT HEIGHT DIFFERENTIAL

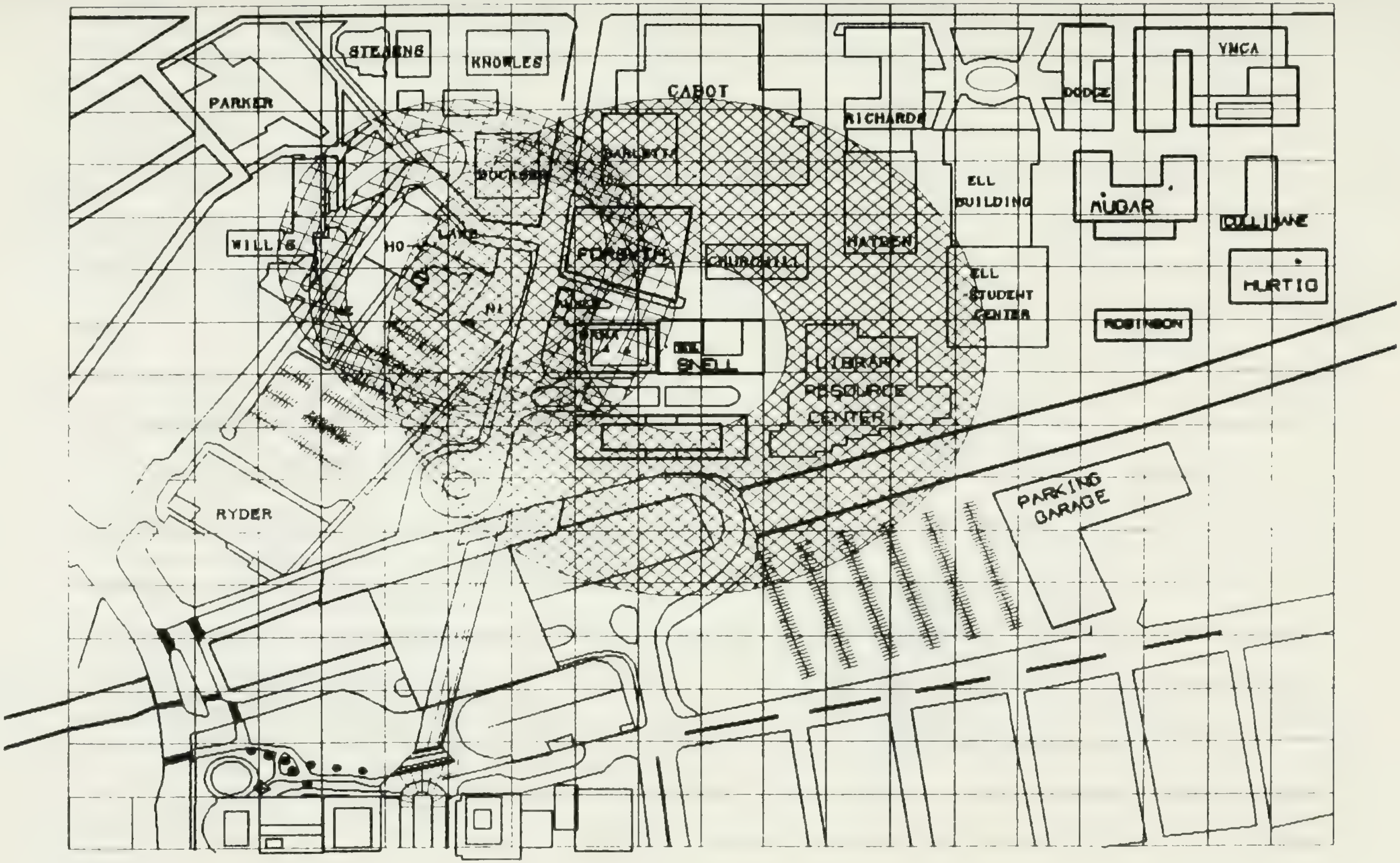
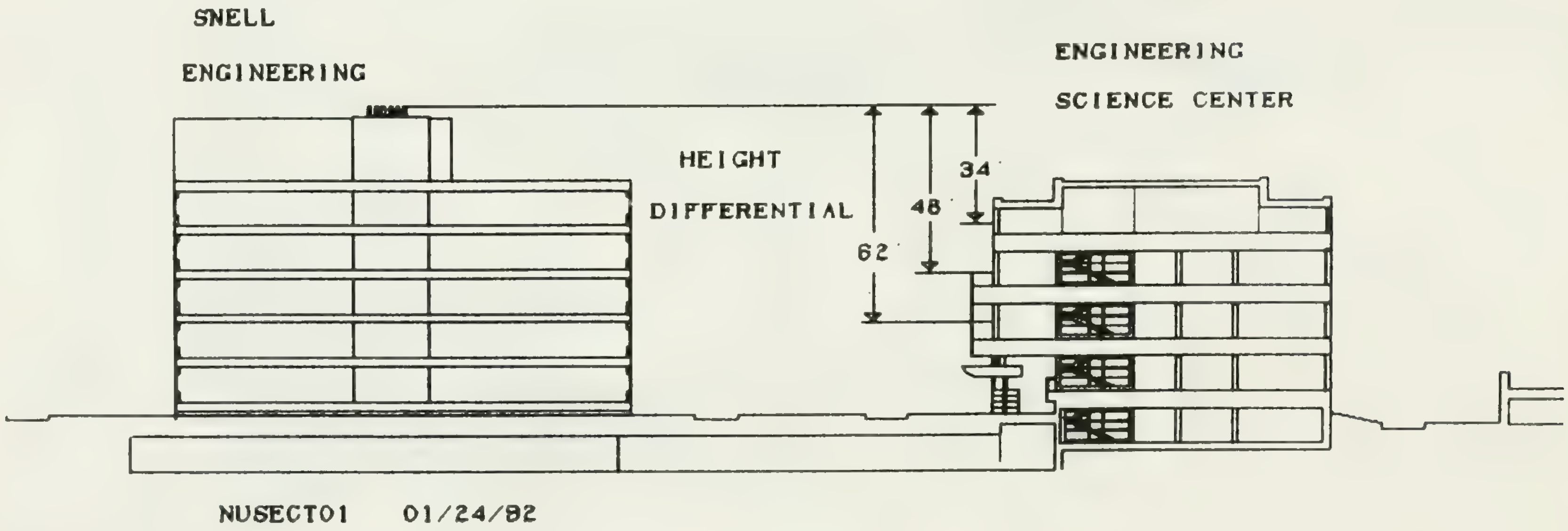


FIGURE 4.6
ZONES OF IMPACT FOR RECEPTORS LOCATED LESS THAN 26 FEET BELOW THE HEIGHT OF THE STACK DISCHARGE

FIGURE 4.7

HEIGHT DIFFERENTIAL BETWEEN STACKS ON THE SNELL ENGINEERING BUILDING AND AIR INTAKES ON THE PLANNED ENGINEERING SCIENCE CENTER



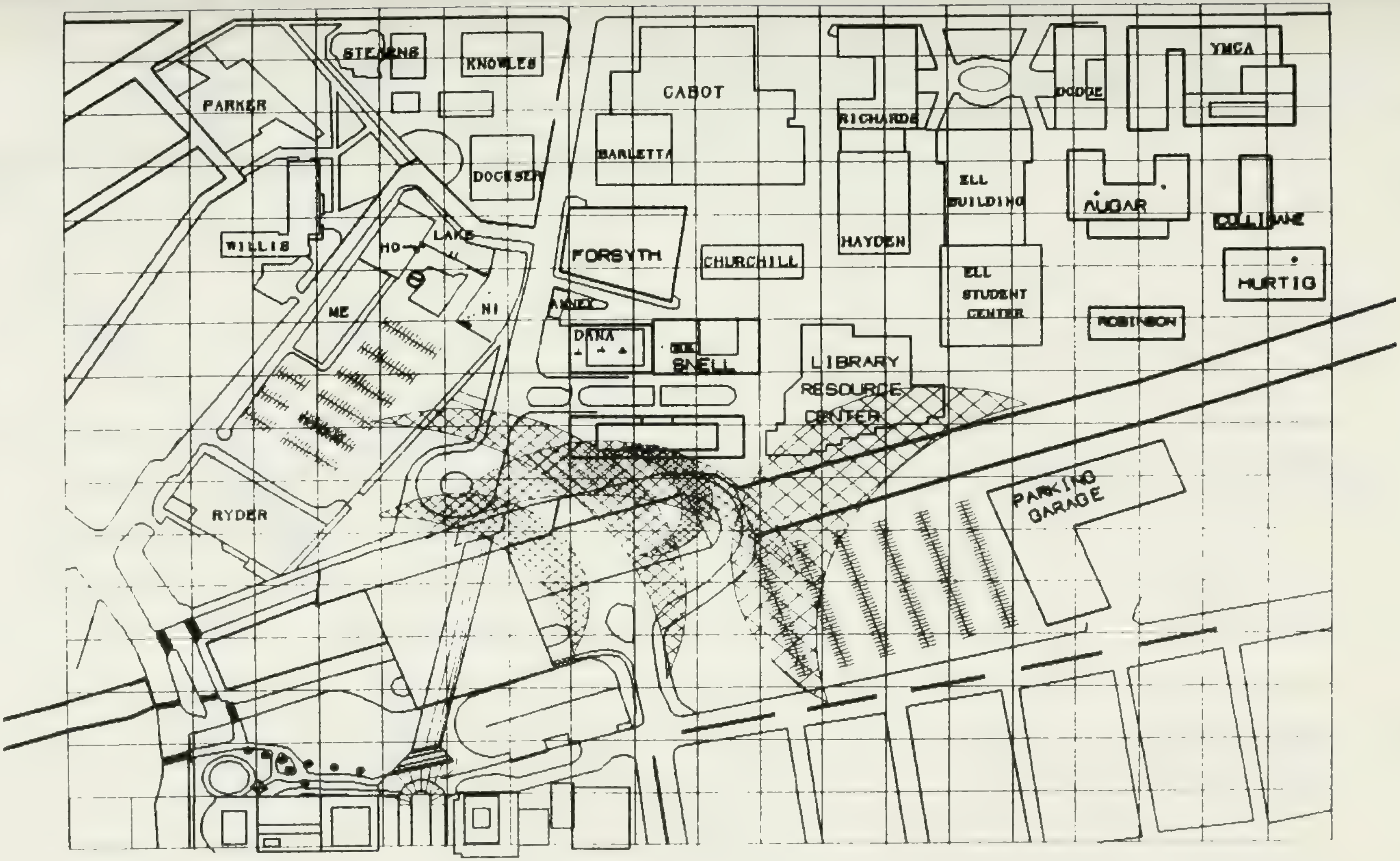


FIGURE 4.8

VEHICLE EMISSION PLUMES FROM CARS BUSES & TRAINS

FIGURE 5.1

COMPARISON OF STACK HEIGHT REQUIREMENTS

4 OPTIONS OF EXHAUST VOLUME, ENGINEERING SCIENCE CENTER

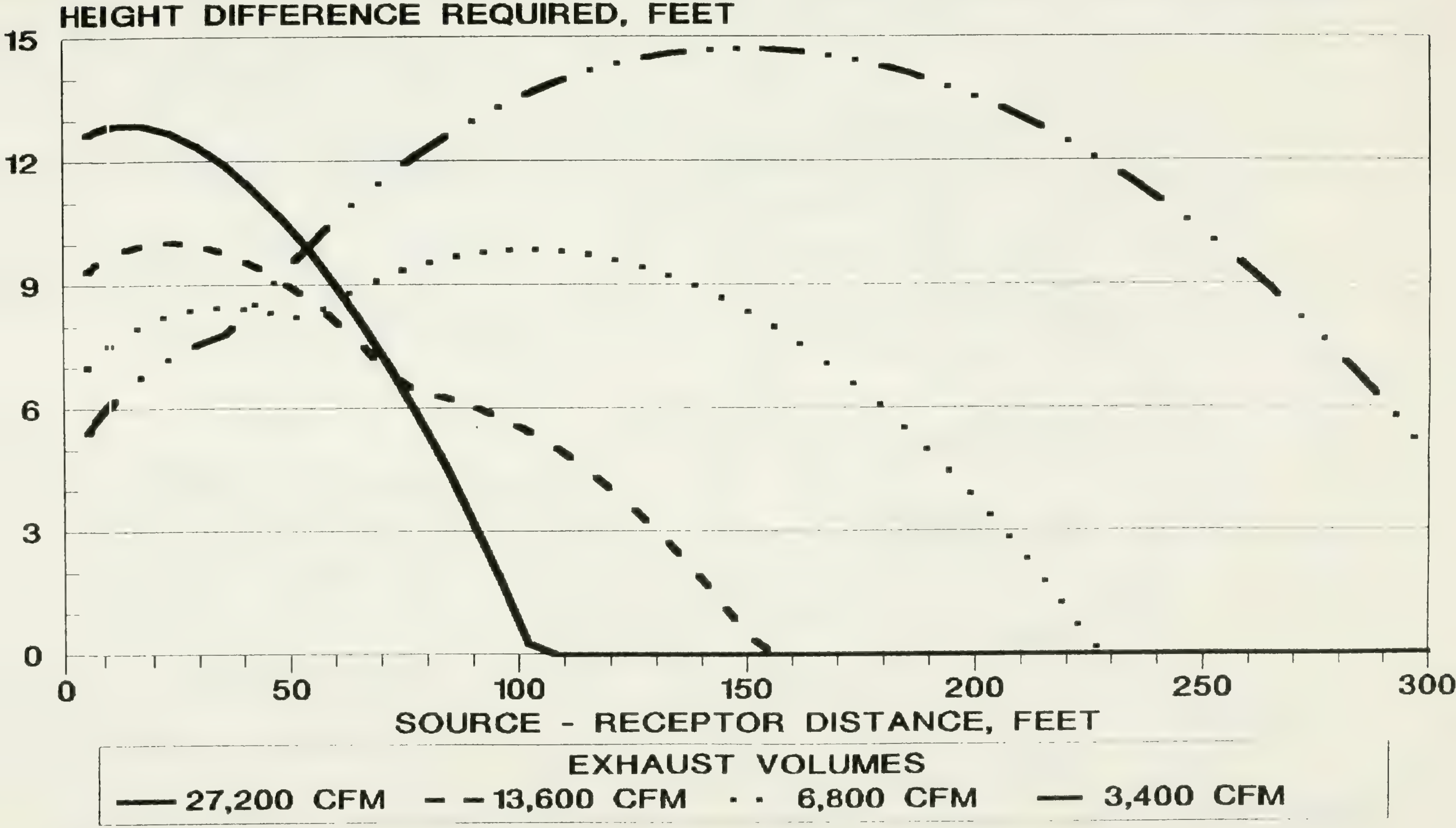


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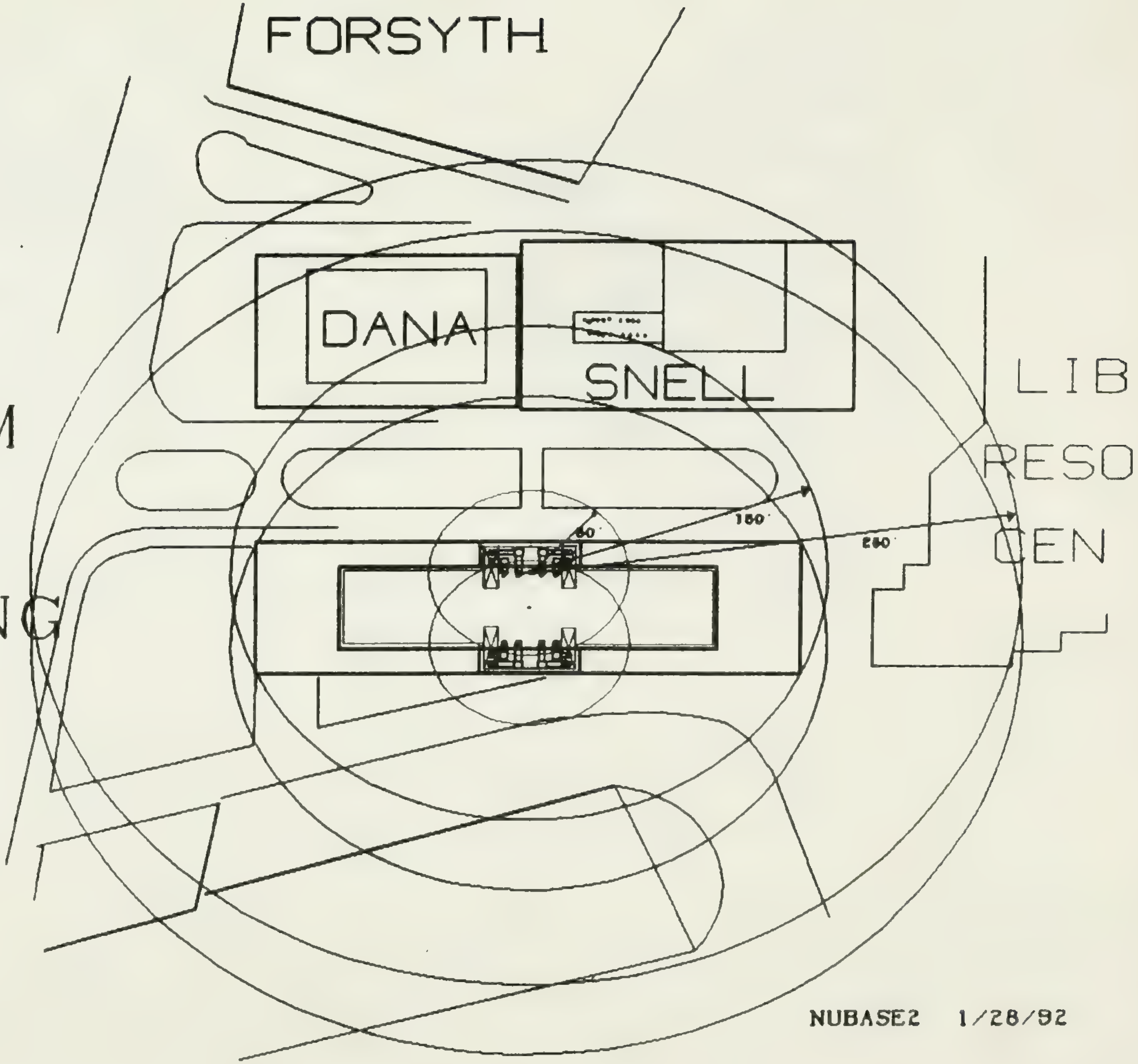
FIGURE 5.2

ZONES OF INFLUENCE AT 50′ 150′ & 250′ FROM STACKS ON ENGINEERING SCIENCE CENTER



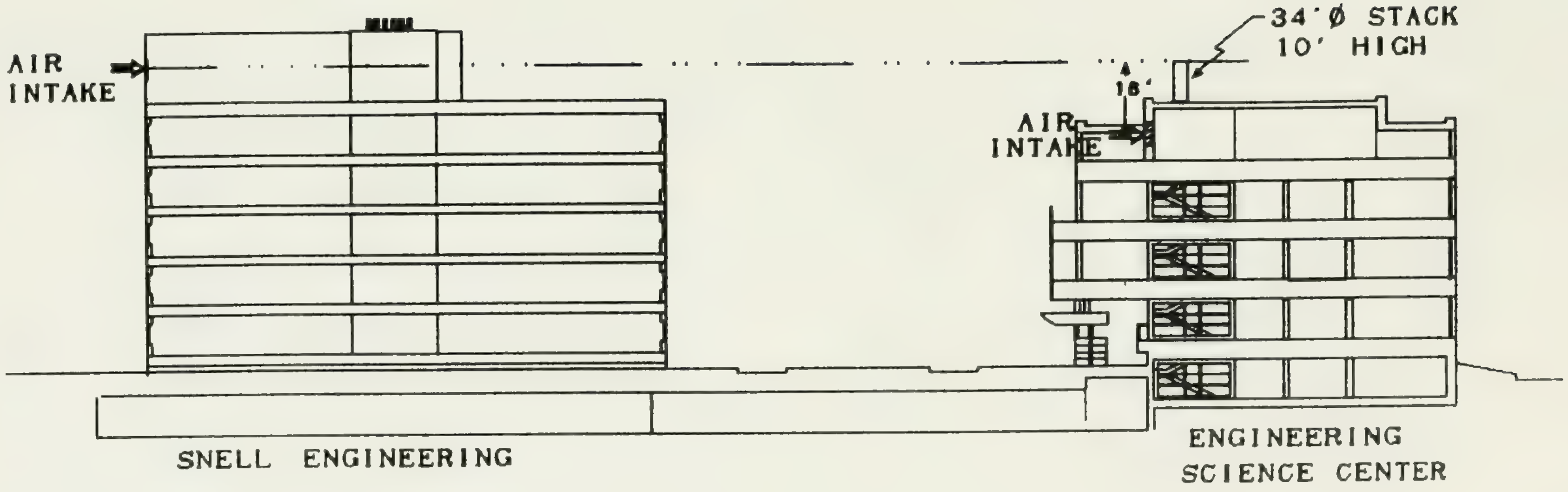


FIGURE 5.3 RELATIONSHIP BETWEEN ESC STACKS AND SNELL ENGINEERING AIR INTAKES

NUSECT02

c. Geotechnical Impact

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER
BOSTON, MASSACHUSETTS

HALEY & ALDRICH, INC.
8 JANUARY 1993

DRAFT PROJECT IMPACT REPORT

ENVIRONMENTAL PROTECTION COMPONENT

Geotechnical Impact

Subsurface Soil and Groundwater Conditions - Subsurface explorations in the form of test borings, test pits and installation of groundwater observation wells were conducted at the project site in September and October 1990. Based on data obtained from the explorations, subsurface soil conditions have been revealed to consist of the following sequence of units in order of increasing depth below the ground surface:

- Miscellaneous Fill, 3 to 12 ft. thick, consisting of a matrix of sand with varying amounts of silt and gravel intermixed with ash, cinders, brick, wood, steel and concrete. Concrete slabs and remains of previous buildings and foundations were also encountered within the fill.

- Organic Soil, underlies the fill as a discontinuous layer, 2 to 3 ft. thick, typically described as organic silt or peat.

- Outwash Sand, 6 to 12 ft. thick, consisting of compact gravelly sand with varying amounts of silt.

- Marine Clay, encountered at depths from 15 to 18 ft. below the ground surface, consisting of gray silty clay, stiff at the top and becoming softer with depth. The thickness of the clay was not determined in the explorations however, based on information from nearby sites it is expected to be 90 to 120 ft. thick.

- Glacial Till, expected to be encountered at depths from 100 to 150 ft. below the ground surface but was not encountered in the on site explorations.

The bedrock underlying the site is known locally as the Cambridge Argillite and is estimated to be at a depth of about 160 ft. below the ground surface though the on site explorations were not drilled deep enough to confirm this.

Groundwater levels at the project site have been observed to range from about El. 4 to 6 (Boston City Base Datum). This corresponds to depths of approximately 9 to 12 ft. below existing site grades. The observed water levels are based on data obtained from groundwater monitoring wells installed at and near the project site. The site groundwater levels will fluctuate naturally due to seasonal variation of such factors as precipitation and temperature as well as due to nearby construction activities.

Foundation Construction Methodology - The proposed structure will have a half-level below grade basement. Basement level construction will require that a general excavation approximately 6 ft. deep be conducted throughout the building area. Excavation for footing construction will be a few feet deeper at individual footing locations. The excavation will remove the layer of miscellaneous fill and organic soil so that the building will be founded on natural inorganic soil consisting of outwash sand or marine clay.

In most areas of the proposed building, there is sufficient space to make an open cut and slope back the sides of the excavation. Adjacent buildings such as the Snell Engineering Center, Snell Library and MBTA Ruggles Street Station are founded below the level of the excavation and are sufficiently removed from the excavation to not be impacted. Ground movement and settlement during excavation are expected to be negligible.

Existing utility lines around the limits of the proposed building are not expected to be impacted by foundation construction since they are a sufficient distance away from the proposed excavation. Utility lines running through the building site will be removed and replaced as part of project construction.

Construction debris generated by the excavation will consist of paving, building rubble and earth material removed for foundation and basement construction. The amount of excavation is estimated to be about 5,000 cubic yards in place. These materials will be disposed of off site in approved landfills in accordance with applicable laws and regulations.

Excavation and permanent foundation construction will be conducted above site groundwater levels. Therefore groundwater levels around the project site will not be impacted. Localized pumping from sumps will be conducted in limited areas to control surface water run-off within excavations.

Solid and Hazardous Waste

A preliminary oil and hazardous materials site investigation has been conducted for the site in accordance with the Massachusetts Oil and Hazardous Materials Release Prevention Act, Chapter 21E of the Massachusetts General Laws (MGL 21E). The study included a review of site history, and previous usage, a Department of Environmental Protection (DEP) municipal file review, a subsurface exploration program and screening and chemical testing of on-site soil and groundwater samples.

Results of chemical testing on soil samples indicate low levels of petroleum contamination within the range commonly encountered in urban fill soils. If hazardous materials are encountered during excavation in quantities requiring remediation such measures will be conducted in accordance with federal, state and local regulations. Zones or pockets of contaminated soil encountered during construction will require special handling and legal disposal in accordance with DEP and other regulations.

Construction Impacts

Foundation Construction - Foundation construction will consist of a relatively shallow excavation for construction of footing and a half-level deep basement. Adjacent structures are located at a sufficient distance from the approximately 6 ft. deep excavation to not be impacted. Construction noise during foundation construction will result from the use of mechanical excavation equipment.

Excavated earth materials will be reused on site as backfill, to the extent possible. Paving materials and building rubble will be separated from the earth materials for disposal at landfills that are licensed to accept construction debris. Excavated material will be trucked offsite for disposal. This will generate approximately 250 truck trips over a one month period during which excavation will take place.

d. Solid And Hazardous Waste

Northeastern University

Office of Environmental Health and Safety

M E M O R A N D U M

TO: Jeanne Levesque

SRB

FROM: Steven R. Brehio

SUBJECT: BRA Scoping Determination

DATE: January 27, 1993

I have enclosed several fact sheets, handbooks and plans relating to the Boston Redevelopment Authority's (BRA) submission requirements for the Scoping Determination. The following items have been included:

1) Northeastern University Procedure for Conducting Autoclave Testing and Record Keeping
2) Northeastern University Procedure for Disposal of Hazardous Waste
3) Northeastern University Infectious Waste Policy
4) Northeastern University Contingency Plan
5) Northeastern University Handbook for Use of Radioactive Materials

Section 4.0 (Hazardous Waste Management) of the "NU Contingency Plan" as well as the "NU Procedure for Disposal of Hazardous Waste" address Section C (4) of the BRA's Scoping Determination.

Section 5.0 (Disposal) of the "NU Infectious Waste Policy", Section X (D) of the "NU Handbook For Use of Radioactive Materials" and the "NU Procedure for Disposal of Hazardous Waste" address how any discharges are restricted into the sanitary sewer system, which is requested in Section C (5) of the Scoping Determination.

An explanation of how biological materials are inactivated and how the inactivation process is verified also requested in section C (5) of the Scoping Determination is addressed in Section 5.0 (Disposal) of the "NU Infectious Waste Policy" and the "NU Procedure for Conducting Autoclave Testing and Record keeping".

Information on training of laboaratory workers and management of hazardous chemicals in laboratories is addressed in a NU Chemical Hygiene Plan, which I can send to you if you require additional information in this area.

Please call me at x2769 if I can be of any help with questions you might have.

229 Forsyth Building
Northeastern University
Boston, Massachusetts 02115
617-437-2769

Northeastern University

Office of Environmental Health and Safety

FACT SHEET NUMBER: 8 DATE: September 1992

PAGE 1 OF 2 REVISION: ORIGINAL

NORTHEASTERN UNIVERSITY PROCEDURE FOR CONDUCTING AUTOCLAVE TESTING AND RECORD KEEPING

1. **GENERAL.** The Commonwealth of Massachusetts under the Sanitary Code requires generators of infectious waste to maintain records of temperature and dwell time when wastes are rendered noninfectious by gas or steam sterilization. In addition to these record keeping requirements, this code requires biological culture testing to assure proper sterilization of all autoclaved material. This is particularly important at Northeastern University as most autoclaved waste that does not contain sharps, is placed into disposal bags by generators for solid waste disposal. Wastes that are` not autoclaved properly may still be infectious, and are inappropriate for solid waste disposal.

2. **RESPONSIBILITIES.** It is the responsibility of each department to insure that record keeping and testing is conducted for each autoclave in their department. Record keeping is best maintained by the individual users of the autoclave. Autoclave testing can be handled by a department designating a "responsible person" for assuring proper operation of the unit. Either a faculty member, laboratory supervisor or technician would be appropriate to designate as a responsible person. The name of the responsible person should be kept in the autoclave log book or posted on or adjacent to the autoclave.

2. **RECORD KEEPING.** All autoclave users prior to autoclaving any waste, must fill all information requested in the autoclave log book. These log books are located adjacent to the autoclaves and should be maintained by the users. As part of an audit program, the Office of Environmental Health and Safety (OEHS) will routinely inspect and retrieve these records so that they may be maintained for the three years designated by the State.

3. **AUTOCLAVE TESTING.** The responsible person is required to conduct biological spore testing of autoclaves at

least monthly and enter results in the autoclave logbook. These spores are available through scientific supply companies such as VWR and Thomas, and are to be purchased by your department. Follow the directions outlined by the supply company for the particular spores you purchase. Most require refrigeration at a temperature of 2 to 8°C when kept in storage. After autoclaving, spores are incubated for a period of up to 48 hours. If the responsible person does not have access to an incubator, OEHS can provide one for loan when necessary. Training and information on autoclave use and testing is available through the Chair of the Institutional Biosafety Committee or OEHS.

4. **PROPER STERILIZATION.** It is important to remember that when contents of the autoclave are packed too tight or the bag is sealed tight, a proper sterilization temperature may not be reached. Temperature, pressure and dwell time may vary between autoclaves, so it is recommended that you review your manual before you autoclave anything. Typical parameters for autoclaving microbiological waste include a temperature of 121°C, at 15 pounds pressure, and dwell time of 15 - 30 minutes depending on the quantity of material being autoclaved. When conducting testing, spores should be placed in the middle of the bag or material to be autoclaved with the bag partially open, so testing assures complete sterilization. This or similar techniques should be used for all autoclaving procedures.

5. **BROKEN AUTOCLAVES.** If it is determined that an autoclave is not working either through testing or other malfunction, the responsible person should be notified so repairs can be scheduled. Use of the autoclave is prohibited until repairs are made. An appropriate warning sign should be put up by the responsible person to warn other people to not use the autoclave.

6. **DISPOSAL OF SPORES.** Live incubated or other live biological spores should be autoclaved again once the autoclave is back in operation or, they may be disposed of through incineration.

ALL USERS OF AUTOCLAVES SHOULD BE FAMILIAR WITH THE UNIVERSITY POLICY FOR THE DISPOSAL OF INFECTIOUS WASTE. FOR COPIES OF POLICIES, REGULATIONS OR ADDITIONAL INFORMATION, PLEASE CONTACT OEHS AT x2769.

Northeastern University

Office of Environmental Health and Safety

FACT SHEET #12 July 1992

Page 1 OF 3 REVISION: Original

NORTHEASTERN UNIVERSITY PROCEDURE FOR DISPOSAL OF HAZARDOUS WASTE

1. **DEFINITION.** A waste is a material no longer used for its original intended purpose and is set aside for disposal. "Hazardous Waste" is defined by the Federal Resource Conservation and Recovery Act (RCRA) as being a waste, or combination of wastes, that because of its quantity, concentration or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in serious irreversible, or incapacitating reversible illness or pose a substantial present or potential hazard to human health, safety or welfare or to the environment when improperly treated, stored, transported, used or disposed of or otherwise managed. This act lists 49 additional pages as criteria and procedure to determine whether a waste is a hazard waste. Because of its length these pages are not listed in this fact sheet, but instead, we strongly recommend you call our office if you are unsure whether your waste snould be classified as a hazardous waste.

2. **SCHEDULING DISPOSAL.** Hazardous chemical wastes are currently picked-up from laboratories once a month after the generator of the waste has called our office (x2769) to be put on a list. Remember your waste can not be picked-up unless you call our office (x2769) and give details with your name, phone number, location, and quantity and type of hazardous waste you have ready for disposal. The schedule for the remainder of the year is as follows:
   - August 20, 1992
   - September 17, 1992
   - October 15, 1992
   - November 19, 1992
   - December 17, 1992

3. **APPROPRIATE CONTAINERS.** All waste must be put into appropriate containers such as glass bottles, plastic containers, or metal containers holding original contents only. No metal containers holding mixed solvents or other material, including water, that was not originally in the container will be accepted. The reason for this

is that metal cans holding mixed chemicals have corroded and have caused major spills in the past. Exception to this rule must be approved by the Office of Environmental Health and Safety (OEHS). Please also note that containers must have secure tops and be compatible with the chemical(s) they are holding.

4. **LABELLING.** All wastes that are hazardous must be clearly identified as "hazardous waste" on the label. In addition, the date when the waste was accumulated as well as an identification of the chemicals or chemical mixtures must also be put on the label. Hazardous waste disposal labels are available through the Office of Environmental Health and Safety and should be used when declaring a material a hazardous waste. Please call in advance for labels so they can be sent to you via University mail prior to the scheduled pick-up.

5. **STORAGE.** Hazardous waste like other chemicals must not be stored on the floor. Appropriate storage areas include a bench top, shelving unit or cabinet. If the material is flammable or combustible, they should be stored in a flammable storage cabinet to keep within fire code restrictions. Please do not use fume hoods as storage areas for hazardous waste or other chemicals.

6. **EMERGENCY SPILL RESPONSE.** Laboratories or departments should have spill kits available to handle small routine spills. Any large or dangerous spills that are beyond the laboratory workers ability to handle it, or is a hazard to health, safety or the environment should not be handled by untrained personnel. In such a situation, the University's emergency number (x3333) should be called, so appropriate emergency spill response can be made. If it appears necessary that the building should be evacuated because of the extent of the spill, then the fire alarm should also be pulled. During such an emergency please make sure you are available, so you may report information on the nature of the spill to emergency responders. If laboratory workers handle a small spill they should consult with OEHS to confirm whether the material recovered should be considered a hazardous waste.

7. **IMPROPER DISPOSAL.** Do not use the sinks or rubbish cans as methods for hazardous waste disposal as this is illegal under Federal, state and local laws. Laboratories and departments do not incur any costs for hazardous waste disposal directly. However, there are

costs to everyone's health, safety and the environment if wastes are improperly disposed of.

8. **WASTE MINIMIZATION.** The U.S. Congress has made waste minimization a national policy and goal of each waste generator. You as a user of chemicals, have the responsibility to minimize the waste you generate. Waste minimization has benefits such as decreasing your exposure to hazardous substances, protection of the environment, and the overall reduction in the cost of disposal which frequently can exceed the original cost of the chemical by 4 to 20 times.

IF YOU HAVE ANY QUESTIONS OR WOULD LIKE TO SCHEDULE DISPOSAL OF YOUR HAZARDOUS WASTE, PLEASE CONTACT THE OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY AT x2769.

N.U. ENVIRONMENTAL HEALTH AND SAFETY PROCEDURES

INFECTIOUS WASTE POLICY

The Policy for the Disposal of Infectious Waste at
Northeastern University

Issued: 3/90

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1.0 GENERAL

Regulations, promulgated on November 6, 1989 (105 CMR 480.000), have made it necessary for Northeastern University to formalize its policy for the disposal of Infectious or Physically Dangerous medical or Biological Wastes. The following are specific operating requirements for the disposal of these materials which must be strictly adhered to in order to assure proper protection of human health and the environment. This policy will not replace State Regulations, but will summarize them and specify requirements that are unique to Northeastern University. It is recommended that everyone who will be generating infectious waste read the State regulations carefully and completely.

2.0 REFERENCE

2.1 105 CMR 480.00

3.0 DEFINITIONS

The State of Massachusetts under the newly amended State Sanitary code (105 CMR 480.000) defines infectious waste in the following manner:

3.1 As waste which because of its characteristics may: cause or significantly contribute to an increase in serious irreversible or incapacitating reversible illness; or pose a substantial present potential hazard to human health or the environment when improperly treated, stored transported, disposed of, or otherwise managed. The following five types of waste are identified and defined as infectious or physically dangerous medical or biological waste. They must be handled in the manner listed in section 5.0 in order to comply with the new Massachusetts Regulations.

3.1.1 Blood and Blood Products
Discarded bulk human blood and blood products in free draining, liquid state; body fluids contaminated with visible blood; and materials saturated/dripping with blood.

3.1.2 Pathological Waste
Human anatomical parts, organs, tissues, and body fluids removed and discarded during surgery or autopsy, or other medical procedures and specimens of body fluids and their containers.

3.1.3 Culture and Stocks of Infectious Agents and Associated Biologicals

All discarded cultures and stocks of infectious agents and associated biologicals, biotechnological by-product effluents (any discarded preparations made from genetically altered living organisms and their products), cultures of specimens from medical and pathological laboratories, cultures and stocks of infectious agents from research laboratories, wastes from the production of biologicals, and discarded live and attenuated vaccines intended for human use.

3.1.4 Contaminated Animal Carcasses, Body Parts and Bedding

The contaminated carcasses and body parts and bedding of all research animals known to be exposed to pathogens.

3.1.5 Sharps

Discarded medical articles that may cause puncture or cuts, including but not limited to all used and discarded hypodermic needles and syringes, pasteur pipettes, broken medical glassware, scalpel blades, disposable razors, and suture needles.

4.0 STORAGE

4.1 Waste generators are responsible for containing and storing infectious waste at all times in leakproof, rodent proof, flytight, containers which ensure that no discharge or release of such waste occurs and that no odor or other nuisance is created. The Office of Environmental Health and Safety (OEHS) will provide containers for the storage of sharps. Other types of waste must be contained and stored in containers provided by the generators.

4.2 All onsite storage of containers of waste shall be in an area away from general traffic flow patterns. Only authorized persons working in the lab shall have access or contact with such waste.

4.3 Sharps shall be segregated from other wastes and aggregated immediately after use in leakproof, rigid, puncture-resistant, shatterproof containers provided by O.E.H.S. Clip boxes are not recommended for use, and will not be provided by O.E.H.S.

4.4 Wastes other than free draining blood and blood products, sharps and biotechnology by-product effluents shall

be placed in a non-permeable 3 mil or greater polyethylene bag and then securely sealed to eliminate leaks.

4.5 Free draining blood and blood products and biotechnology by-product effluents shall be stored at all times in leakproof containers that are securely sealed.

5.0 DISPOSAL

5.1 The following methods of treatment and disposal are currently acceptable for generators of infectious waste at Northeastern University:

5.1.1. Steam sterilization
5.1.2. Gas sterilization
5.1.3. Chemical disinfection
5.1.4. Incineration at an approved incineration facility

5.2 The Office of Environmental Health and Safety (OEHS) will provide disposal bags for all material that is treated on campus. These bags will be used to identify the material as noninfectious and will meet all the labelling requirements in section (6.0). Generators will still be required to provide their own autoclave bags (3 mil thick) when handling and treating the waste on site. All wastes not treated on campus and to be sent out for incineration will be placed in boxes provided by OEHS.

5.3 In addition, the following wastes identified below must be handled in the following manner:

5.3.1 Blood and Blood Products

5.3.1.1 Since Northeastern University is connected to a municipal sewerage system or septic system, free draining blood and blood products except blood saturated materials may be disposed of into these systems. This method is not presently restricted by the Massachusetts Water Resources Authority (MWRA).

5.3.1.2 If the above method is not practical or it should become prohibited by the MWRA, blood and blood products, except blood saturated materials, shall be

placed in an additional 3 mil bag and transferred into an infectious/biohazard box provided by OEHS. Once properly packaged and manifested they will be scheduled by OEHS to be sent to an approved disposal facility. They may also be rendered noninfectious by gas, chemical or steam sterilization and placed in a disposal bag provided by OEHS and discarded as regular rubbish. This method is preferred as it will limit disposal costs for the University.

5.3.2 Sharps

5.3.2.1 Containers of sharps will be disposed of at an approved incineration facility. Scheduling or requests for disposal will be handled by OEHS.

5.3.3 Blood Saturated Materials, and Cultures and Stocks of Infectious Agents and Associated Biologicals

5.3.3.1 These wastes shall either be: Rendered noninfectious on site by steam sterilization, incineration, thermal inactivation, or in the case of liquids, chemical disinfection. Once these wastes have been treated as above they must be put into an additional 4 mil disposal bag provided by OEHS. These bags will clearly identify the generator responsible for the treatment and will also identify the waste as noninfectious medical or biological waste, or; see section 5.3.3.2

5.3.3.2 If on-site treatment is not available, wastes should be placed in a second 3 mil bag and transferred into a infectious/biohazard box provided by OEHS. Once properly packaged, labelled and OEHS notified, OEHS will arrange transport to an approved disposal facility.

5.4. Biotechnology By-Product Effluents

5.4.1 These wastes shall not be removed from Northeastern University unless the viable organisms containing recombinant DNA molecules have been rendered noninfectious by a validated method. The following methods shall be used as appropriate:

a) Steam sterilization
b) Chemical disinfection

5.4.2 The methods which rely on heat will be evaluated mechanically and biologically by OEHS by using a recording thermometer and indicator microorganisms with defined

heat susceptibility pattern.

5.4.3 If these wastes are rendered noninfectious by chemical disinfection, the chemical used shall be of demonstrated efficacy against the target or indicator organism.

5.4.4 Once rendered noninfectious, biotechnology by-product effluents may be disposed of directly into the waste generator's connection to the municipal sewerage system or septic system unless such disposal is otherwise restricted by the authorized approving agency. OEHS should be contacted to determine whether treatment has rendered material appropriate for this manner of disposal.

5.4.5 If the generator of the waste is prohibited from disposing of biotechnology by-product effluent through the municipal sewerage system or septic system, then the waste will be rendered noninfectious and disposed of in a manner designated by OEHS.

5.5 Pathological waste and Contaminated Animal Carcasses

5.5.1 These wastes must be doubled bagged and placed in a box provided by OEHS for incineration at an approved disposal facility. OEHS will coordinate all scheduling of disposal activities and assure manifests are filled out correctly by generators.

6.0 LABELLING

6.1 Every container or bag of waste which has not been rendered noninfectious shall:

6.1.1 Be distinctly marked with the international biohazard symbol and colored red to indicate that it contains waste, and in the case of sharp wastes, be distinctly labeled to indicate that it contains sharp waste capable of inflicting punctures or cuts. These sharp containers will be provided by OEHS.

6.2 Every container or bag of waste which has not been rendered noninfectious and which will be transported off the premises of the waste generator shall in addition to the requirements of section 6.1 shall be placed in boxes which are:

6.2.1
- a) rigid
- b) leak resistant
- c) impervious to moisture
- d) of sufficient strength to prevent tearing or bursting under normal conditions of use and handling
- e) sealed to prevent leakage during transport

6.2.2 Each box shall bear a label which states the name, address and telephone number of the generator. The label shall be affixed in a manner which ensures that it cannot be easily removed.

6.2.3 Boxes meeting these requirements will be provided by OEHS.

6.3 Prior to transport for off-site disposal, waste which has been rendered noninfectious by a method other than incineration shall be placed in a 4 mil disposal bag so as to clearly identify it as noninfectious medical or biological waste and to identify the waste generator responsible for the treatment. Once clearly signed, bagged and sealed, such waste may be disposed of in the same manner as regular rubbish handled by the House and Grounds Keeping Department.

6.3.1 The generator will be required to clearly sign the disposal bag in the appropriate area.

7.0 RECORDKEEPING

7.1 The waste generator shall maintain records of temperature and dwell times used in each instance where waste has been rendered noninfectious by gas or steam sterilization. There will be a log sheet at each autoclave for the generator to fill out to record this information. Biological spore tests will routinely be done by OEHS to verify efficiency of the autoclave. The above records will be stored at OEHS and retained for at least three years.

7.2 The waste generator shall also maintain records of volume and type of waste rendered noninfectious on-site which shall be available for OEHS review. OEHS will provide a standard form for all generators to use. Such records shall be retained for at least three years.

8.0 MANIFESTS

8.1 OEHS will assist generators in preparing manifests when necessary. The generator shall appoint a designee to prepare and sign the manifest. Original copies will be sent to OEHS to maintain for the appropriate period of time.

8.2 Manifests provided by OEHS will include the following information:

8.2.1 Description of waste to be shipped;
8.2.2 Total quantity of waste; and
8.2.3 Type of container in which waste is transported

9.0 COMPLIANCE

9.1 It is expected that all employees, students, and contractors of Northeastern University adhere to this policy. Non-adherence may be grounds for disciplinary action.

Contingency Plan

The Emergency Preparedness and Prevention Plan of
Northeastern University, Boston, Massachusetts

November 1992

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1.0 Introduction

This document outlines the emergency response and prevention procedures of Northeastern University. These procedures have been designed to minimize risks to the public health, safety and the environment from spills, explosions, fire and the release of hazardous materials/wastes.

This contingency plan has been developed as part of the Northeastern University Office of Environmental Health and Safety Management Program in compliance with the following regulations of the Massachusetts Department of Environmental Protection (see Appendix):

- Requirements for Hazardous Waste Generators (310 CMR 30.300)
- On-Site Accumulation by Large Quantity Generators [310 CMR 30.340(d)(2)]
- Contingency Plan, Emergency Procedures, Preparedness, and Prevention (310 CMR 30.520-524)

Although no specific regulation covers contingency planning for radioactive or infectious materials/waste, this document may also be used in an emergency involving these materials. In sections of this document where hazardous materials/waste are mentioned, it will be assumed that it can refer to hazardous "chemical", radioactive, or infectious materials/waste, unless it specifically mentions otherwise.

2.0 Emergency Response Procedures

This section outlines the emergency response procedures of Northeastern University. These procedures have been designed to assist emergency response personnel and associated organizations in preparing for potential fires, explosions and/or environmental incidents at the University.

As required by the Standards for Emergency Prevention and Response [310 CMR 30.524 (6)] of the Massachusetts Department of Environmental Protection, whenever there is an imminent or actual emergency, the Emergency Coordinator or on-duty Alternate Emergency Coordinator shall immediately perform the following tasks:

1. Activate University alarms or communication systems, where applicable, to notify appropriate University personnel.
2. Notify the Massachusetts Department of Environmental Protection. See Section 2.2.2, Emergency Coordinator Duties.
3. Notify other appropriate state or local agencies with designated response roles if their help is needed. See Section 2.1, Emergency Response Contact Information.

An "emergency" shall be defined as a threat to public health, safety, or welfare or the environment from fires, explosions, spills or any unplanned sudden or non-sudden release of hazardous material/waste or hazardous material/waste constituents to air, soil, surface water, or ground water. Should an incident not meet any of the above criteria, but a release of hazardous material/waste occurs in excess of reportable quantities identified under the Massachusetts Oil and Hazardous Material List, then this release shall also be designated an emergency.

If no emergency is identified or reportable quantity release occurs, the hazardous material/waste incident will be handled using appropriate sections of the Contingency Plan when necessary, but no state or local notification will be required.

Laboratory or other small spills should be evaluated using the above criteria in determining whether an actual emergency exists. A small spill in itself should not constitute an emergency if the material is not hazardous or the spill can easily be handled by the responsible party. It is only when an incident involving hazardous material/waste is an emergency as defined above or is a Massachusetts Oil and Hazardous Material listed release in excess of reportable quantities that an emergency should be declared.

NOTE: Copies of this contingency plan have been distributed to the following:

STATE:	Department of Environmental Protection
BOSTON:	Boston Fire Department Boston Police Department Boston Department of Health & Hospitals Brigham and Women's Hospital University Hospital

In addition, copies have been sent to the following emergency response vendors:

Advanced Environmental Technology Corporation

Chemical Waste Management

Clean Harbors Environmental Service Company

2.1 Emergency Response Contact Information

This section contains the names, addresses and phone numbers of emergency response personnel and associated organizations, including hazardous material spill control contractors:

Note: All communications are coordinated by the Northeastern University Police Operation Center (POC). The POC has direct communication lines ("ring-down") to the Boston Police Department, the Boston Fire Department and the Northeastern University Lane Health Center. In addition, Northeastern University staffs and operates an ambulance at the Boston campus.

GENERAL EMERGENCY PHONE NUMBER: x3333 [(617) 437-3333]
(Northeastern University Police Operation Center "POC")

NORTHEASTERN UNIVERSITY
EMERGENCY COORDINATOR: (617) 437-2769
(Steven R. Brehio, Office of Environmental Health and Safety)

BOSTON FIRE DEPARTMENT: **x3333**

BOSTON POLICE DEPARTMENT: **x3333**

BOSTON DEPARTMENT OF HEALTH & HOSPITALS: **x3333**

NORTHEASTERN UNIVERSITY OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY: (617) 437-2769

NORTHEASTERN UNIVERSITY PHYSICAL PLANT: (617) 437-2754

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP),
INCIDENT RESPONSE DIVISION: (617) 935-2160

DEP 24 HOUR EMERGENCY: (617) 739-7226
(Northeast Region, Woburn, Massachusetts)

HAZARDOUS MATERIAL SPILL CONTROL CONTRACTORS:

- Advanced Environmental Technology Corporation
  (508) 460-9960
- Chemical Waste Management, Inc.
  (603) 487-3763
- Clean Harbors Environmental Services Company
  (800) 645-8265 [(800) OIL-TANK]

HOSPITALS: **x3333**

NATIONAL EMERGENCY RESPONSE CENTER: (800) 424-8802

U.S. COAST GUARD RESPONSE CENTER: (800) 424-8802

2.2 Emergency Coordinator

As required, Northeastern University has appointed an Emergency Coordinator to coordinate the plans and procedures outlined in this contingency plan.

To ensure an Emergency Coordinator is available, the University has appointed a primary emergency coordinator, identified as the Emergency Coordinator, and an Alternate Emergency Coordinator.

2.2.1 Emergency Coordinator Designation

EMERGENCY COORDINATOR:

Name: Steven R. Brehio
University Telephone Number: (617) 437-2769
Home Telephone Number: Contact the Division of Public Safety at (617) 437-2769
Page Number: (617) 339-3058

University Address:
Northeastern University
229 Forsyth Building
Boston, Massachusetts 02115

ALTERNATE EMERGENCY COORDINATORS:

Name: Jack Price
University Telephone Number: (617) 437-2769
Home Telephone Number: Contact the Division of Public Safety at (617) 437-2769
Page Number: (617) 546-3349

University Address:
Northeastern University
229 Forsyth Building
Boston, Massachusetts 02115

2.2.2 Emergency Coordinator Duties

The emergency coordinator's responsibilities will include, though not limited to, the following duties:

(a) Preparedness and Prevention

The emergency coordinator shall be thoroughly familiar with all aspects of the Northeastern University Contingency Plan, all operations and activities at the University, including the location and characteristics of the waste handled, the location of all applicable records within the University and the University layout.

(b) Emergency Assessment

Whenever there is a fire, explosion, or other release, the emergency coordinator shall:

1. Immediately identify the character, exact source, amount, and extent of all released materials, and concurrently

2. Assess possible hazards to public health, safety, or welfare, or the environment that may result from the fire, explosion, or other release. This assessment shall consider both direct and indirect effects of the fire, explosion, or other release, for example, the effects of any hazardous effluents from water and chemical agents used to control fire or heat induced explosions.

(c) Emergency Notification

If the Emergency Coordinator determines that the University has had a fire, explosion, or other release which could threaten public health, safety, welfare or the environment, or is a reportable quantity release, the Emergency Coordinator shall:

1. Immediately notify appropriate officials if the Emergency Coordinator's assessment indicates the evacuation of local areas may be advisable. The coordinator shall be available to help appropriate officials decide whether local areas should be evacuated; and shall

2. Immediately notify the Incident Response Division of

the Massachusetts Department of Environmental Protection and the designated emergency coordinator for the City of Boston, or the National Response Center at (800) 424-8802.

The Emergency Coordinator shall convey to these parties the following information:

- Name and telephone number of the on-duty Emergency Coordinator,
- The University's name and address,
- The type of incident, i.e., fire, explosion, and/or spill,
- The names and quantities of materials involved,
- The extent of injuries (to the extent known),
- The possible hazards to public health, safety, welfare or the environment outside the University (to the extent known)

(d) Incident Control

During an emergency the Emergency Coordinator will take all reasonable precautions necessary to ensure that fires, explosions, run off, and other releases are handled in an effective manner. Special efforts will be made so that damage does not spread to non-university property or to hazardous waste accumulation areas within the University. Such efforts shall include, but are not limited to, an immediate call to the Boston Fire Department, use of drum repair kits and appropriate spill control equipment.

(e) Remediation

If the University must stop operating or evacuate a building or area in response to a potential or actual fire, explosion or other release the Emergency Coordinator shall conduct the following remedial activities:

1. Monitor for leaks, pressure build-up, gas generation, and ruptures in valves, pipes and other equipment, wherever appropriate.
2. Collect, store and dispose of all wastes and hazardous wastes generated by the incident, including contaminated surface waters and soil.
3. Ensure that incompatible wastes are not disposed or stored in the affected area.

4. Clean, recharge, and reactivate the emergency equipment identified in this contingency plan.

5. Ensure that operations are not resumed in the affected area until the Emergency Coordinator or if necessary, the Massachusetts Department of Environmental Protection determines that there is no longer a threat to public health, safety, welfare or the environment.

(f) Incident Reporting

The Emergency Coordinator shall note in the University's operating record the time, date, and details of any incident that requires implementing the contingency plan.

Within 7 days the Emergency Coordinator shall submit an incident report to the Massachusetts Department of Environmental Protection. The report provides the information specified in the Operating Record's Incident Report Form. See Section 5.1, Spill Incident Reporting Procedures.

2.3 Communications

2.3.1 Lines of Communication

Emergency response communications will be coordinated by the Northeastern University Division of Public Safety.

The Division of Public Safety's Police Operations Center (POC), coordinates communications for all emergency response activities within the University. The POC is equipped with a variety of alarm and two-way communication devices including direct lines to the Boston Police Department and Boston Fire Department (see Section 2.3.2, Communications Equipment).

(a) Notification Instructions

In cases of hazardous material/waste emergencies, including fire, explosion or spills, individuals will be instructed to contact the Northeastern University Division of Public Safety by dialing x3333.

These Instructions for emergency notification shall be placed at key locations within the University, including all locations of hazardous "chemical" waste generation and/or accumulation.

These instructions will be in the form of a poster or Chemical Hygiene Plan, which will state the following emergency response procedure:

(b) Division of Public Safety Response

Upon being notified of an emergency by the University's internal alarm system and/or by a telephone report, the Northeastern University Division of Public safety will contact the Emergency Coordinator and/or the on-duty Alternate Emergency Coordinator. The Emergency Coordinator or Alternate Emergency Coordinator will be contacted via telephone or paging beeper.

Note: Also, as determined by the nature of the emergency, the Northeastern University Division of Public Safety may directly notify the appropriate external response organization(s) (fire department, police department, etc.), if the Emergency Coordinator or Alternate Emergency Coordinator are not immediately available.

(c) Emergency Coordinator Response

Upon notification of an emergency or potential emergency the Emergency Coordinator will immediately commence the coordination of an appropriate response by performing the duties specified in Section 2.2.2. Emergency Coordinator Duties.

(d) Public Relations Response

The University Communications Office will be responsible for all external public relations during a hazardous material/waste emergency. All press releases will be coordinated through the Director of Public Relations or by his or her designee.

2.3.2 Communications Equipment

All Central and satellite hazardous waste accumulation areas are equipped with telephones for direct access to the Northeastern University Police Operations Center (POC) in the event of a hazardous material/waste emergency. Other University emergency communications capabilities are listed in a supplement to this Contingency Plan available for use or review at the Northeastern University Police Operations Center (POC) located at the Division of Public Safety, 100 Columbus Place.

2.3.3 Alarm Systems

All listings and descriptions of the University Alarm System are found in a supplement to this Contingency

Plan available for use or review at the Northeastern University Police Operations Center (POC) located at the Division of Public Safety, 100 Columbus Place.

2.4 University Emergency Response Personnel

University Emergency Response Personnel consist primarily of three groups: University Division of Public Safety, Lane Health Center, and the Office of Environmental Health and Safety.

2.4.1 Division of Public Safety

The Division of Public Safety located at 100 Columbus Place provides a comprehensive delivery of all police, emergency medical, fire safety, parking, security and related public safety services to the University community for all situations including hazardous material/waste emergencies. Most police officers are trained as Emergency Medical Technicians (EMTs) and receive retraining on a regular basis.

2.4.2. Lane Health Center

The Lane Health Center located in room 135 Forsyth Building provides student health services and the treatment and care of occupationally related illnesses and injuries of the faculty and staff. Doctors or nurses are on staff 24 hours a day and are capable of providing services or appropriate referral during a hazardous material/waste incident.

2.4.3 Office of Environmental Health and Safety

The Office of Environmental Health and Safety located in room 229 Forsyth Building provides services to the University community for the identification, evaluation, control and compliance for all environmental, health, and safety situations on campus. During a hazardous material/waste emergency, this Office will have trained staff available to advise laboratory personnel or others involved in an emergency. In the event that a hazardous material/waste emergency should exceed the University's capabilities, an appropriate Hazardous Material/Waste Control Contractor will be called in as outlined in previous sections of this document.

2.5 Emergency Response Equipment

This section lists the inventory of emergency response equipment available at Northeastern University's Boston Campus.

All communication or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment will be tested and maintained as necessary to ensure its proper operation in time of emergency.

2.5.1 Fire Emergency Equipment

A listing and description of the University Fire Emergency Equipment is found in a supplement to this Contingency Plan available for use or review at the Northeastern University Police Operations Center (POC) located at the Division of Public Safety, 100 Columbus Place, Boston.

2.5.2 Ambulance

The University ambulance is located in the Forsyth Building on the Northeastern University, Boston campus.

2.5.3 Hazardous Spill Emergency Equipment

Hazardous material/waste emergency spill equipment, in addition to what is available in many laboratories, are located at spill stations in all major science buildings. Typical supplies available at these stations or available at the Office of Environmental Health and Safety include the following:

- flammable solvent absorbent and spill kits
- hydrofluoric acid spill kits
- acid neutralizers and spill kits
- caustic neutralizers and spill kits
- mercury absorbents, vacuum and spill kits
- radioactive material washes and cleaners
- respirators
- gloves
- hard hats
- face shields and goggles
- tyvec lab coats and jump suits
- boots
- hearing protectors
- drain covers

2.5.4 Medical Emergency Equipment

A listing and description of the University Medical Emergency Equipment is found in a supplement to this Contingency Plan available for use or review at the Northeastern University Police Operations Center (POC) located at the Division of Public Safety, 100 Columbus Place, Boston.

3.0 Incident Prevention Procedure

This section describes Northeastern University's procedures to prevent incidents due to fire, explosion or the release of hazardous material/waste to the environment.

3.1 Employee Training

The Office of Environmental Health and Safety oversees the training of employees in several safety programs to ensure occupational safety. The safe handling and proper disposal of chemicals is a key part of the employee training program. Other important aspects are the proper selection of materials, substitution of less hazardous chemicals, engineering controls, personal protective equipment and waste minimization.

3.1.1 Chemical Hygiene Plan

Northeastern University's Chemical Hygiene Plan, which is a Management Plan developed in response to the OSHA Laboratory Standard, has incorporated employee training in the safe handling and disposal of hazardous material/waste. Each department that uses potential hazardous chemicals as part of research has identified a Chemical Hygiene Officer who is responsible to coordinate safety training for laboratory employees and to disseminate information from the Office of Environmental Health and Safety, as safety programs are updated.

3.1.2 Physical Plant Employees

Hazard Communication training for Physical Plant employees has incorporated incident prevention procedures for hazardous materials used in conjunction with the operation of the Northeastern University facilities. Underground storage tank monitoring and the use of refrigerants are two programs implemented by the Physical Plant Department with consultation from the Office of Environmental Health and Safety.

3.2 Fire

A description of the University Fire Prevention Procedures is found in a supplement to this Contingency Plan available for use or review at the Northeastern University Police Operations Center (POC) located at the Division of Public Safety, 100 Columbus Place.

3.3 Hazardous "Chemical" Material/Waste Releases

All hazardous "chemical" wastes are transferred and shipped by licensed and approved hazardous waste transporters. Personnel used for transfer and shipping are either trained field chemists or have been employed for a sufficient time to have

become competent as field chemists. All have undergone at a minimum, the 24 hour OSHA Emergency Response Training (20 CFR 1910.120) along with weekly retraining in various areas.

Transfer of wastes between site of generation and storage is accomplished through either carts with retaining walls or adequate physical separation to guard against breakage. Disposal bottles provided to laboratories to accumulate wastes in are either put into storage cabinet or benches, provided quantities do not exceed fire code requirements.

Waste storage areas have 8" curbing and drainless floors. Lightning is explosion proof. All flammables and combustibles are kept in flammable storage cabinets. Other wastes are separated by hazard category on appropriate shelving. At the present time no wastes are stored in underground storage tanks.

3.4 Radioactive Material Releases

Northeastern University has established a Radiation Safety Committee and Radiation Safety Office to assure protection of public health, safety and the environment from any release of radioactive material/waste.

The Committee regulates and controls the use of ionizing radiation assuring protection of Northeastern University personnel and the general public against radiation hazards associated with possession, use, transportation and disposal of radioactive materials/waste. The Committee also provides for compliance with all applicable regulations of federal, state and local agencies.

The Radiation Safety Office operates under the authority of the Radiation Safety Committee. It is charged with the responsibility for the day-to-day operations of the NU program.

3.5 Infectious/Biohazardous Releases

Northeastern University has established a Biosafety Committee and Biosafety Office to assure public health, safety and the environment from any release of infectious materials/waste.

The Institutional Biosafety Committee is primarily responsible for the conduct of recombinant DNA research for compliance with all applicable guidelines. Recently it has expanded its authority and is now also overseeing projects involving infectious agents and sharps.

The Office of Environmental Health and Safety through its Biohazard Assessment program implements all the committees programs. In addition, the office manages an infectious waste program assuring proper disposal of this waste stream.

3.6 Prevention of Hazards

Through our training programs and hazardous material/waste procedures, hazards to the public health, safety, or welfare or the environment from fires, explosions, spills or other unplanned or non-sudden release of hazardous material/waste or hazardous material/waste constituents to air, soil, surface water, or ground water are either reduced or eliminated.

3.7 Evacuation Plan

Because quantities of hazardous "chemical" material/waste used at Northeastern University are typically handled in small quantities (500 ml - 4 l), it is not anticipated that a formal written evacuation plan for the entire University will be necessary. It is expected that University fire and alarm systems currently in place will provide for the adequate evacuation routes and alternative evacuation routes for hazardous material/waste spills or fires.

4.0 Hazardous Waste Management Procedures

Northeastern University's Boston Campus is classified by the regulations of the Massachusetts Department of Environmental Protection as a large quantity generator of hazardous waste. Subsequently, the University has submitted a Notification of Hazardous Waste Activity to Region I of the United States Environmental Protection Agency and has been assigned an EPA Hazardous Waste Identification Number (EPA Number). The Northeastern University EPA Number is MAD001423631.

For radioactive materials/waste, the University is licensed by the U.S. Nuclear Regulatory Commission and is authorized by this license to receive, acquire, possess, and transfer by-product, source and special nuclear material designated on its license. The Northeastern University Radioactive Materials license is 030-13307.

Infectious waste is regulated under the State of Massachusetts Sanitary Code. No formal licensing or registration process is required.

4.1 Generation Profile

4.1.1 Hazardous "Chemical" Materials/Waste

Teaching and research projects produce the majority of the hazardous wastes generated by the University. Corrosive, ignitable, reactive, toxic and listed hazardous wastes are sporadically generated by laboratories located throughout the campus. In general, hazardous waste generation occurs in small, "lab-scale", volumes (500 ml to 4 l).

4.1.2 Radioactive Materials/Waste

Approximately 25 laboratories generate a variety of radioactive wastes on campus. These wastes represent a number of radionuclides in forms consisting of solid material, solidified liquids and liquid scintillation vials.

4.1.3 Infectious Materials/Waste

Science related departments on campus are the major generators of infectious waste on campus. These wastes consist of blood and blood products; pathological waste; culture and stocks of infectious agents and associated biologicals; contaminated animal carcasses, body parts and bedding; and sharps.

4.2 Collection

The University's hazardous "chemical" wastes are collected and transported (See Section 4.2, Collection) to the primary

hazardous waste accumulation area in room 30 Hurtig Hall. At this time, Northeastern University subcontracts its hazardous "chemical" waste handling activities to an outside vender. This vender collects and segregates all hazardous "chemical" wastes generated throughout the University.

Radioactive wastes are transported by lab personnel to a central waste collection area located in room 310C Mugar. Segregated waste are put into DOT 30 or 55 gallon drums according to waste classification.

Infectious wastes are managed largely by the departments that generate them. Wastes appropriate for autoclaving are handled by lab workers who treat them and then put them into waste disposal bags appropriate for solid waste disposal. Wastes that can not be autoclaved are put into shipping boxes set up throughout the University and shipped out to an incinerator from several locations within the University.

4.3 Accumulation

This section provides the location and description of the hazardous waste accumulation areas within Northeastern University. The main accumulation area is in the basement of Hurtig Hall. All University hazardous wastes are stored in the Hurtig Hall Accumulation Area prior to transportation to a Treatment, Storage or Disposal Facility (TSDF) or Low-level Waste Disposal Facility.

No hazardous "chemical" wastes are stored on campus for over 90 days.

Radioactive materials with a physical half-life of less than 65 days are stored on site until no longer radioactive. Materials with a physical half-life of over 65 days are sent to a licensed low-level radioactive waste disposal facility.

NORTHEASTERN UNIVERSITY HAZARDOUS WASTE ACCUMULATION AREAS (Boston campus):

LOCATION	HAZARDOUS WASTE DESCRIPTION
Room 30 Hurtig Hall	Ignitables, Corrosives, Reactives, Toxics & Listed (hazardous "chemical" wastes).
Room 27 Hurtig Hall & Room 310C Mugar Bldg.	Liquid Scintillation Vials Solids and solidified liquids. (radioactive wastes).

4.4 Transportation

Hazardous wastes generated by Northeastern University are transported by licensed hazardous waste transporters. As

required, hazardous waste manifests accompany each shipment. Manifest records of each hazardous waste shipment, including verification of disposal, are maintained by the Northeastern University Office of Environmental Health and Safety.

4.5 Disposal

Hazardous wastes generated by Northeastern University are disposed by licensed Treatment, Storage and Disposal Facilities. Hazardous waste disposal records are maintained by the Northeastern University Office of Environmental Health and Safety.

5.0 Operating Records

This section contains incident reporting and inspection procedures. Actual records of incidents and inspections will be maintained by the Northeastern University Office of Environmental Health and Safety.

5.1 Incident Reporting

Whenever an incident requires the implementation of this contingency plan a report must be submitted to the Massachusetts Department of Environmental Protection.

The report must be submitted within 7 days and contain the information specified in the Northeastern University Incident Report Form. See Section 5.1.1

5.1.1 Incident Report Form

Northeastern University Incident Report Form
Boston, Massachusetts (617) 437-2769

Emergency Coordinator Information

Steven R. Brehio
Northeastern University
Office of Environmental Health and Safety
229 Forsyth Building
Boston, Massachusetts 02115
(617) 437-2769

Incident Information

Date: ____________________
Time: ____________________
Type of Incident (fire, explosion, spill, etc.):

Materials Involved

List names of materials involved and quantities.

MATERIAL	QUANTITY

Extent of Injuries

List extent of injuries, if any.

Assessment of Potential Hazards

If applicable, describe potential hazards to public health, safety, welfare or the environment.

Recovered Material

List the disposition and quantity of recovered material that resulted from the incident, e.g., the disposition of contaminated soil or fire debris.

Contingency Plan Discrepancies

List the differences in the actual emergency response activities from those prescribed by the Northeastern University Contingency Plan, and the reasons for each such difference.

Prevention of Similar Incidents

Describe measures to be taken to prevent a similar incident.

5.2 Inspection Procedure

This section outlines the inspection procedures for hazardous waste accumulation areas and emergency response equipment.

Inspections described in this section will be conducted by the Northeastern University Office of Environmental Health and Safety.

5.2.1 Emergency Response Equipment

All emergency response equipment specified in Section 2.5.3, Hazardous Spill Emergency Equipment, shall be inspected on a monthly basis to ensure adequate inventory and proper operation. An inspection log will be kept at each emergency response equipment location to detail inspections and replacement of inventories.

5.2.2 Hazardous Waste Accumulation Areas

Hazardous "chemical" waste accumulation areas within the University will be inspected weekly. Each hazardous "chemical" waste container will be inspected for leaks, proper labelling and adequate spacing. Each accumulation area will be inspected for leaks, incompatible materials and signs of deterioration. An inspection log will be kept at each hazardous waste accumulation area to detail frequency of inspections.

5.2.3 Emergency Response Form

Following an emergency requiring implementation of the Contingency Plan, an emergency response form or report will be filled out.

5.3 Contingency Plan Amendments

As required by the Massachusetts Department of Environmental Protection, this contingency plan shall be reviewed and immediately amended, if necessary, whenever:

1. The plan fails in an emergency;
2. The list of emergency coordinators changes;
3. The list of emergency equipment changes;
4. There is a change in the operation or maintenance of the University which affects this plan.
5. There occurs any other circumstances which indicates the need for a change in this contingency plan.

5.4 Contingency Plan Distribution

As required by the regulation 310 CMR 30.522 of the Massachusetts Department of Environmental Protection, copies of this contingency plan have been submitted to the following organizations:

1. Boston Fire Department.
2. Boston Police Department.
3. Boston Department of Health and Hospitals.
4. Brigham and Women's Hospital.
5. University Hospital.
6. Advanced Environmental Technology Corp.
7. Chemical Waste Management, Inc.
8. Clean Harbors Environmental Service Co.
9. Department of Environmental Protection.

Transmittal letters are appended. Appendix D.

HANDBOOK FOR USE OF RADIOACTIVE MATERIALS AT NORTHEASTERN UNIVERSITY

Revised April 1980
December 1982
December 1987
January 1992

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Appendix A General Safety Instructions and Precautions for Radionuclide Users

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I. Northeastern University Radiation Safety Committee

A. Purpose

Northeastern University Radiation Safety Committee has been established for the following purposes:

1. To regulate and control the use of ionizing radiation at Northeastern University and to provide for the protection of Northeastern University personnel and the general public against radiation hazards associated with the possession, use, transportation and disposal of radioactive materials by Northeastern University.

2. To provide for compliance with all applicable regulations of federal, state and local agencies.

B. Organization of the Committee

The Radiation Safety Committee of Northeastern University is appointed by and responsible to the President of the University. Membership is balanced among the various departments concerned with the use of radioactive material and radiation sources, and allows for non-voting representation by service groups such as Physical Plant, House and Groundskeeping, Transportation and Public Safety.

C. Delegation of Authority

The Radiation Safety Committee receives its authority from the President of Northeastern University. The Committee is charged with the following:

1. The establishment and continuing review of an adequate radiation safety program at the University.

2. The continuing compliance with radiation safety regulations of state, federal and local agencies.

3. The administration of the NRC Byproduct Material license, under which all work with radioactive materials is conducted at the institution.

D. Committee By-Laws

In carrying out these responsibilities, the Committee conducts a program of licensing, review and evaluation of proposals for use of radionuclides, and continuing surveillance of the use of such materials with a view to maintaining standards of safe handling practice and radiation control. Following are the by-laws under which the Committee operates:

1. Only full members hold voting privileges on matters pertaining to the licensing and control of radioactive materials. An alternate will vote only in the absence of the corresponding full member.

2. A meeting quorum shall consist of a majority of those voting members listed. Issues shall be decided by a majority vote of those members present and voting.

3. A voting member with a vested interest in an issue under discussion may be present during the discussion of the issue only insofar as he/she may provide information to other members. He/she may not be present during final debate and balloting and shall not cast a vote on that issue.

4. Meeting shall be held at least four times per year on a regular meeting schedule acceptable to the Committee. Special meetings may be convened by the Chairperson either on his own initiative or at the request of another member. The agenda for all meetings shall be distributed at least one week prior to the meeting.

5. A complete record of all committee actions shall be retained by both the Chairperson and the Secretary.

II. Northeastern University Radiation Safety Office

A. The Radiation Safety Office operates under the authority of the Radiation Safety Committee. It is charged with the responsibility for day-to-day operation of the Northeastern University Radiation Safety Program and lists the following activities:

   1. Registration of workers who will be involved in the handling of radioactive materials and ionizing radiation sources.

   2. Providing, as necessary, personnel monitoring for radiation exposure.

   3. Providing, as necessary, radionuclide laboratory inspection, radiation surveys, and area monitoring.

   4. Collecting and disposing of radioactive waste.

   5. Determining that adequate radiation protection instruments are available and properly calibrated.

   6. Leak testing of sealed radioactive sources.

   7. Ordering and receipt of all radioactive material.

8. Monitoring all shipments of radioactive materials to determine compliance with applicable shipping regulations.

9. Following-up radiation incidents and decontamination operations as necessary.

10. Maintaining required radiation protection records.

B. In addition, the Radiation Safety Office is available for consultation on laboratory design, shielding, and other radiation exposure control methods and assisting in the training of radiation workers in radionuclide handling techniques. The Radiation Safety Office will provide indoctrination of new employees involved with the handling of radioactive material. In general, the Radiation Safety Office is responsible for the implementation of the entire Northeastern University Radiation Protection Program.

Manpower to perform the above tasks include the Radiation Safety Officer and an Assistant Radiation Safety Officer who are normally present on the campus and available throughout the working day, a part-time graduate student-technician, plus part-time, professional Health Physics consultants who oversee the program and assist in satisfying the NRC requirements for the Byproduct Material License issued to this University. Emergency notification instructions for 24-hour on-call availability of Radiation Safety support is posted in each radionuclide laboratory.

III. NRC Byproduct Material License

Northeastern University has been issued a specific NRC Byproduct Material License from the U.S. Nuclear Regulatory Commission. This license covers all uses of byproduct material within the campus, giving full responsibility for control and proper use of such materials to the Radiation Safety Committee. The NRC imposes no specific limitations with respect to radionuclide, chemical compound, or quantity to be applied to specific uses on campus, but specifically delegates such authority to the local committee subject to general regulations of the NRC as published in the Federal Register. The license also specifies a list of conditions of approval, all of which must be continually satisfied in the conduct of work involving radioactive materials on the campus. Compliance with these conditions and regulations is included in the responsibilities of the Radiation Safety Committee and its administrative arm, The Radiation Safety Office.

IV. Responsibility of Investigators

A. In their preliminary review of proposals for the use of radioactive materials in a department or laboratory within

the University, the Radiation Safety Committee will designate the responsible investigator(s) for each such project. Each such designated investigator is responsible for the following:

1. Providing the Radiation Safety Office with up-to-date data relative to the rooms or areas in which radioactive materials are stored or handled (including the cessation of work with radionuclides).
2. Notifying the Radiation Safety Office of any changes in the listing of personnel who may be handling radioactive material or who may be exposed to the ionizing radiation therefrom during the course of their work.
3. Maintaining an accurate record of the amount of radioactive material under his/her control at any one time, and establishing an adequate system to insure that he/she does not possess more than that quantity of material for which he/she is licensed.
4. Insuring that radioactive material is disposed of by authorized means.
5. Using the radioactive material for those uses authorized.
6. Informing the Radiation Safety Office of changes in procedure which may increase the probability of radiation exposure or laboratory contamination.
7. Insuring that personnel wear appropriate monitoring devices during periods of possible exposure.
8. Establishing that radioactive materials are properly controlled within the project, and that they are properly stored at the end of each work day (such storage shall include securing against unauthorized removal).
9. Equipping the laboratory with adequate survey and/or monitoring equipment to aid in the safe handling of radioactive material.

B. The Principal Investigator responsible for supervising the radiation safety aspects of a new Authorization will be required to demonstrate qualifications in this regard in one of the following ways:

1. Principal Investigators who have been previously so designated by the NRC in a specific license comparable to that which is sought by their Authorization will be required to demonstrate their knowledge (by written

exam) of the rules and regulations applicable to their proposed use at Northeastern University.

2. Other prospective Principal Investigators will be required to demonstrate sufficient knowledge and background to meet the requirements of the NRC for supervision of the proposed use. At a minimum, all Principal Investigators must demonstrate training and experience of at least 40 hours in the areas of: 1. principles and practices of radiation protection, 2. radioactivity measurement, standardization, and monitoring techniques, 3. biological effects of ionizing radiation. Training, radiation safety assistance and supervision will be provided as necessary and a written examination covering all aspects of the NRC required knowledge will be required. As an alternative, the Committee will accept successful completion of a radiation safety training course which is approved in advance by the Committee.

V. Application for Permission to Use Radionuclides

Each proposed use of radionuclides must be applied for through the Radiation Safety Committee. This is accomplished by completing an Application for Authorization form obtainable from the Radiation Safety Office and submitting it to the Committee through the Radiation Safety Office (Stephen Larson, Radiation Safety Officer, Room 229 Forsyth Building). This application will be reviewed by the Committee as indicated above and appropriate action taken to authorize the proposed use. All radioactive material used at Northeastern University must be approved in this way. Small quantities of materials listed as "license exempt" or "general license" by various suppliers may not be utilized except through normal Radiation Safety Committee authorization and purchasing procedures.

VI. Amendments to Established Radionuclide Use

Application for amendment to an approved application should be made in writing to the Radiation Safety Committee for any change in responsible personnel, use, or procedure mentioned in the original application. Applications involving only personnel or minor procedural changes may be requested by letter. The Radiation Safety Office, Office of Environmental Health and Safety, 229 Forsyth Building, should be informed in writing of any change in personnel who work with radionuclides. Changes in the departmental personnel monitoring requirements should be requested of the Radiation Safety Office in writing as soon as possible, in order to insure that each such person receives adequate personnel monitoring promptly.

VII. Procurement and Inventory

A. Ordering

To assure compliance with the regulations of the Nuclear Regulatory Commission and State Department of Public Health, all purchases of radioactive material and radiation producing equipment must be approved by the Radiation Safety Office under the direction of the Radiation Safety Committee. In keeping with the regulations, the following procedures will be followed:

1. The ordering user will prepare the purchase requisition, complete with a statement of current inventory of requested material and the user's current authorization number, and forward it to the Office of Environmental Health and Safety for appropriate action as follows:
   a. If the radionuclide and form designated have been approved for the user and the purchaser is within his/her possession limit, it will be approved and the Radiation Safety Officer will place the order.
   b. If the quantities and type of radioisotopes have not been approved for the user, the purchase requisition will be held and the user notified of the steps to take to obtain the necessary approval.
2. Each ordering user is instructed to have all incoming shipments addressed to the user in care of the Radiation Safety Office, Stephen Larson, 229 Forsyth Building, Northeastern University for package check-in and inventory control. Additionally, all potential suppliers of radionuclides to Northeastern University are notified that all shipments of radioactive material addressed to the University shall be addressed to the attention of the Radiation Safety Office.

B. Receiving

All radionuclide shipments are received in the Radiation Safety Office. Radiation Safety will monitor the shipment within the federally prescribed time interval and deliver to the user that placed the order. The responsible investigator is required to keep an accurate record of each shipment while it is in his possession, and thereby maintain the possession limits for the approved applications assigned to him/her. All radionuclide containers will be retained for collection by the Radiation Safety Office for final disposal. There is no mechanism for receiving any packages during off-duty hours

at Northeastern University and all suppliers have been so notified.

VIII. Radiation Sources Not Approved by the Radiation Safety Committee

The Radiation Safety Committee has the authority to confiscate any and all ionizing radiation producing materials and equipment which are not purchased, used and possessed in accordance with the rules and regulations herein.

IX. Training

There are essentially three levels of training applicable to persons potentially exposed to ionizing radiation at the University. These may be described as follows:

A. Principal Investigators

Such individuals will usually have had applicable previous experience and/or formal training elsewhere. This will be supplemented as necessary by Radiation Safety staff and each such individual will be required to pass an appropriate written examination. These individuals are then designated as supervisors of other registered radiation workers and are responsible for their day-to-day supervision and training relative to radiation safety.

B. Registered Radiation Workers

These individuals, all of whom work under the supervision of a Principal Investigator, are provided with basic radiation safety training by the Radiation Safety Officer (or designee). For long term workers, this basic training will be updated annually through lecture, written materials or both. Records of all such training by the Radiation Safety Office are maintained in the Current Personnel file for each Principal Investigator.

C. Those Subject to Peripheral Exposure

This category, including secretaries to groups working with radionuclides, dishwashers, cleaning staff, and security guards will be offered a brief training program appropriate to their potential exposure.

Since University regulations include the requirement that all materials be shielded and secured at the end of each working day, the cleaning staff and security guards should not be subject to significant exposure. However, part 19 requirements and appropriate precautions in primary work areas are emphasized. This training is also updated at appropriate intervals, depending on employee turnover

rates and significant alterations to laboratory design and construction.

D. Students

It is anticipated that undergraduate students will be restricted to very low level (less than 10 uCi per student) under direct supervision. For each such use, the students will first receive an appropriate radiation safety lecture by the Radiation Safety Officer (or designee).

Graduate students working under an approved Authorization will be classified as Registered Radiation Workers and be trained accordingly.

X. Regulations for the Safe Handling of Sources of Ionizing Radiation

The following are specific operating regulations applicable to all projects in which sources of ionizing radiation are used. General safety instructions and precautions for radioactive materials users are outlined in Appendix A.

A. Possession Limits

Each approved application includes a maximum possession limit for each radionuclide requested in the application. This limit is the maximum quantity which may be possessed by the Principal Investigator for this proposed use. Radiation Safety Committee processing of the application includes comparison of the possession limit requested with that of all previously assigned to other Authorizations with the NRC possession limit for that radionuclide for the entire University. Observance of such assigned possession limits by all projects is essential to insure compliance with the NRC overall limit. Inventory records maintained by each Principal Investigator should readily yield current information as orders are placed with the Radiation Safety Office.

B. Storage

Each Principal Investigator under the NRC Byproduct Materials License stores its own radionuclides for day-to-day use in a designated place under lock and key. These storage areas may or may not be shielded depending on the amount and type of radioactivity to be stored. A central storage room, Room 310A, B and C Mugar Science Center, for larger quantities of rarely used material or material no longer of use to the Principal Investigator, as well as for bulk radioactive waste, is established under the control of the Radiation Safety Office.

C. Monitoring

Laboratories using radionuclides are monitored weekly by the Radiation Safety Office. Laboratories using less than 1 millicurie quantities of radionuclides may be monitored less frequently.

A record of this monitoring and of personnel monitoring is kept by the Radiation Safety Office. The above described monitoring program is designed to provide only the minimum legal record of radiation monitoring. It provides for routine monitoring by the Radiation Safety Officer (or designee) at intervals that would minimize the spread of contamination or loss of activity before the consequences became serious. This program is intended as a supplement to the radiation monitoring that is required of any individual working with radioactive materials. It is the prime responsibility of all laboratory personnel to perform whatever monitoring is necessary on a day-to-day or hour-by-hour basis depending on the procedures involved and the radionuclides being handled at the time. A more detailed description of the monitoring program is outlined in Appendix B.

D. Waste Disposal

1. All waste disposal is handled by the Radiation Safety Office. Principal Investigators handling radioactive material will provide waste containers for solid waste which are plainly marked "CAUTION RADIOACTIVE WASTE TO BE EMPTIED BY RADIATION SAFETY STAFF ONLY". These containers are checked by the Radiation Safety Office at least weekly and emptied upon request of the Principal Investigator. The radioactive waste is then either (1) stored until it has decayed sufficiently to be disposed of as non-radioactive, or (2) turned over to a NRC licensed disposal company. Storage for decay is limited to those radioactive materials with a physical half life of 65 days or less with storage for at least 10 physical half-lives. Final check of unshielded waste must be conducted with a G-M survey meter with no detectable dose above background at time of disposal as non-radioactive waste.

   All waste material generated in the laboratory that is suspected of being contaminated with radioactive materials at any level should be disposed of as radioactive waste.

   NRC licensed radioactive waste disposal firms such as Radiac Research Corp. or U.S. Ecology will be used for proper disposal of radioactive materials.

2. Old radionuclide containers (empty or partially full) which are no longer useful to the Principal Investigator are stored in the laboratory storage area until collected by the Radiation Safety Office. These bottles are disposed of through a licensed disposal firm. It is important that no waste which exhibits any radiation sign, label or similar designation be disposed of in the ordinary waste containers in the laboratory. Such improper disposal into public waste sites can lead to radiation scares and public relations problems.

3. Radioactive waste materials which are soluble or dispersible in water can be disposed of in the sanitary sewerage systems in amounts averaging less than 0.5 mCi per Authorization per day total activity. No more than 2 mCi may be disposed of in this way at one time in any laboratory or no more than 100 mCi total radioactivity may be flushed into the sanitary waste system by each Principal Investigator in any given year. Disposal of larger amounts or liquids insoluble in water must be conducted by the Radiation Safety Officer (or designee). Whenever possible, residual levels of stock materials that are surplus and other high concentration waste should be kept in the smallest volume possible and disposed of through the Radiation Safety Office rather than into the sanitary waste system. Efforts must be made by the Principal Investigator to minimize disposal into the sanitary waste system.

   Any sink and drain used to discharge liquid wastes into the sanitary system will be designated and posted as such. A sink log disposal is affixed near the sink and the sink disposal inventory record must be completed by the radiation worker.

   Concentration of liquid waste at the time of disposal must be less than the limit specified in Appendix B, Table 1, Column 2 of Title 10, Part 20 CFR. Following are typical examples of permissible disposal concentrations:

Isotope	Concentration (uCi/liter)
190 Au	2
82 Br	8
14 C	20
45 Ca	0.3
47 Ca	1
57 Co	20
58 Co	4
60 Co	10
51 Cr	50

55 Fe 20

Isotope	Concentration (uCi/liter)
59 Fe	2
3 H	100
197 Hg	9
125 I	0.04
131 I	0.06
42 K	9
54 Mn	4
22 Na	1
24 Na	6
32 P	0.5
35 S	2
75 Se	9
85 Sr	3
87m Sr	0.09
90 Sr	0.01
99m Tc	200

E. Control of Radiation Exposure

Under all circumstances exposure to ionizing radiation shall be kept at the lowest practical level. The external and internal total exposure from sources of radiation shall be controlled in such a way as to assure that no individual shall receive a total dose in excess of the following values:

1. Maximum permissible doses for persons who are registered as radiation workers shall not exceed the following:

    a. Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads 1.23 rems/calendar qtr

    b. Hands and forearms, feet and ankles 18.75 rems/calendar qtr

    c. Skin of whole body 7.50 rems/calendar qtr

    d. Fertile women (with respect to fetus) 0.5 rems in gestation period

2. Maximum permissible doses for non-radiation workers:

    a. Individual members of general public 0.5 rem/year

    b. Population average limit 0.17 rem/year

    c. Students 0.1 rem/year

3. The above values in 1 and 2 are in addition to natural background radiation exposure and to radiation administered for medical reasons. (Natural background exposure amounts to approximately .120 rem/year in eastern Massachusetts).

Internal exposure is controlled by minimizing airborne release of radionuclides through the proper utilization of hoods, closed reaction systems, temperature control, mechanical pipetting devices and/or any such appropriate mechanism. Monitoring for adequacy of such procedures is summarized in Appendix C.

Radiation dosimetry services are contracted through R.S. Landauer Co. and include whole body film badges and extremity thermoluminescent dosimeters (finger rings) as necessary. Monthly reports of each registered radiation worker are provided to the supervising Principal Investigator. Follow-up with each worker on unreasonable doses will be conducted by the Radiation Safety Office as required by the ALARA program of the Radiation Safety Office.

F. Transportation of Radioactive Material

The NRC Byproduct Material License includes no provision for the transportation of radioactive material outside of the University premises. Under no circumstances should any user pick up radioactive material from a supplier, return an improper shipment to the supplier, borrow radioactive material from another University in the area, or in any way transport radioactive materials in his/her private vehicle. Such transportation of material must be by authorized transportation agencies and in compliance with Department of Transportation regulations. Should such transportation become necessary, contact the Radiation Safety Office for assistance. The transportation of radioactive materials within the institution (hand-carrying from laboratory to laboratory) shall be done in such a manner as to assure a minimum chance of contamination. All material must be doubly contained and never left unattended. Under no circumstances should the dose rate on the surface of the container being carried exceed 100 millirem/hour, nor should the dose rate one meter from the surface of the carrying container exceed 10 millirem/hour.

G. Caution Signs and Labels

Each area in which radioactive material is used or stored shall be posted with appropriate signs, in conformity with 10 CRF 20, Section 20.203. These signs shall be installed or removed only by or with the approval of the Radiation Safety Office. Additionally, each Principal Investigator

should post each laboratory with sufficient emergency notification information so that a knowledgeable laboratory person could easily be contacted in the event of a laboratory emergency during non-working hours.

Each container in which radioactive material is to be stored for a period of time must be labelled in conformance with appropriate Federal Regulations. Specifically, the label must contain the words "Caution Radioactive Material" along with information regarding: (1) the quantity and kind of radioactive material in the container, (2) the date of assay, and (3) the person responsible for the material. Appropriate labelling tape is available from various commercial suppliers. Labelling is not required for laboratory containers such as beakers, flasks, test tubes used transiently in the laboratory in the presence of the user.

H. Use of Animals Containing Radioactive Materials

Refer to Appendix F

I. Emergency Procedures

Refer to Appendix D for step by step procedures to be followed in most accident/incident situations that are likely to be encountered in a normal laboratory setting.

Should a laboratory fire occur in which there is a probability of radioactive materials involvement, the following procedures should be followed in order:

1. Notify local fire department and/or pull local alarm

2. Notify the Radiation Safety Office (x2769) and Northeastern University Public Safety Division (x3333) of the situation

3. Await arrival of fire department and Radiation Safety Office representatives and provide whatever additional information is requested

4. If Radiation Safety Office representative does not appear, inform ranking fire department representative of the presence and amount of radioactive material, but instruct the fire department to fight the fire as necessary using standard respiratory protective equipment

5. Do not allow the fire department to attempt clean-up of the laboratory or their potentially contaminated equipment until Radiation Safety Office representatives are present

The Radiation Safety Office is available to help in any emergency involving radioactive material. The NRC regulations governing the use of byproduct materials include strict reporting requirements with regard to emergencies. In order to comply with these regulations, it is important that all spills, accidental ingestions, misplacement or loss of radioactive material be reported immediately to the Radiation Safety Office.

APPENDIX A

NORTHEASTERN UNIVERSITY

RADIATION SAFETY OFFICE

GENERAL SAFETY INSTRUCTIONS AND PRECAUTIONS FOR RADIONUCLIDE USERS

All individuals working with radioactive materials will adhere to the following minimum safety requirements:

A. Maintain daily exposure to radiation as low as possible.

B. No smoking, eating, drinking, use of cosmetics or storage of food or beverages will be permitted in any area where unsealed sources of radioactive materials are used, handled, transferred or stored.

C. No mouth pipetting of radioactive solutions will be permitted.

D. After handling unsealed radioactive material, hands shall be washed before leaving the laboratory and exposed skin, hair and/or clothing shall be surveyed for contamination.

E. When hand or clothing contamination is possible, protective gloves and lab-coat shall be worn.

F. Insure that containers of radioactive materials are appropriately marked and labelled indicating the contents, date, and responsible user.

G. Objects and equipment which may have been contaminated shall not be removed from the controlled area without appropriate prior survey for the presence of contamination. If contamination is detected, the object or piece of equipment must be satisfactorily decontaminated as directed by the Radiation Safety Office.

H. Whenever practical, the user should perform a trial experimental run using a non-radioactive (or low activity) material to establish the adequacy of equipment and procedures.

I. Prior to performing operations with a radioactive source emitting a potentially high level of ionizing radiation, radiation levels will be measured. Handling tongs or a suitable remote handling device must be used for handling a sources or container which emits a dose rate at contact in excess of 500 millirem per hour.

J. Any operation which may produce airborne radioactive contamination (i.e. evaporations, use of volatile compounds,

powders, sanding, grinding, etc.) must be conducted with appropriate exhaust ventilation approved by the Radiation Safety Office. When recommended by the Radiation Safety Office, filtration of the effluent air shall be provided.

APPENDIX B

NORTHEASTERN UNIVERSITY

RADIATION SAFETY OFFICE

AREA SURVEY PROGRAM

I. Individual users of unsealed radioactive materials are expected to perform routine area surveys of the work places and laboratories to insure that working surfaces, floor, equipment, etc. are free of removable contaminations and that external radiation exposures are maintained at a minimum. Each Principal Investigator shall be required to obtain a suitable survey instrument in the initial review of their application.

II. In addition to self-evaluation, the Radiation Safety Officer will perform area surveys of radiation work areas at appropriate intervals to insure that external and internal exposure of personnel to radiation is maintained as low as possible.

AREA SURVEY PROCEDURES

A. All radioactive materials handling areas will be surveyed daily with an appropriately low-range survey meter and decontaminated if necessary. For daily surveys where no abnormal exposures are found, only the date, the identification of the personal performing the survey, and the survey results need be recorded.

B. Laboratory areas where only small quantities of radioactive materials are used (less than 200 uCi) will be surveyed monthly.

C. Waste storage areas and all other laboratory areas will be surveyed weekly.

D. The weekly and monthly measures will consist of:

1. A measurement of radiation levels with a survey meter sufficiently sensitive to detect 0.1 mR/hr.

2. A series of wipe tests to measure contamination levels. The method for performing wipes will be sufficiently sensitive to detect 200 dpm per 100 cm2 for the contaminant involved. Wipes of preparation areas or other "high background" areas will be removed to a low background area for measurement.

E. A permanent record will be kept of all survey results,

including negative results. The record will include:

1. Location, date, and identification of equipment used, including the serial number and pertinent counting efficiencies.
2. Name of person conducting the survey.
3. Drawing of area surveyed, identifying relevant features such as active storage areas, active waste areas, etc.
4. Measured exposure rates, keyed to location on the drawing (point out rates that require corrective action).
5. Detected contamination levels, keyed to location on drawing.
6. Corrective action taken in the case of contamination or excessive exposure rates, reduced contamination levels or exposure rates after corrective action, and any appropriate comments.

F. Area will be cleaned if the contamination level exceeds 200 dpm/100 cm2.

HOW TO COMPLETE THE AREA SURVEY RECORD FORM*

A. Purpose of this form:

The purpose of this form is to standardize the format for recording the results of routine area surveys. These surveys are specified in both the Handbook, Appendix B and in the Conditions of Approval for each Authorization to Possess and use Radioactive Materials at Northeastern University.

B. Procedures:

*1. Geiger-Miller count rate meters, liquid scintillation and solid scintillation counters are all potential survey instruments.

*2. For persons using sealed sources only and which do not create a radiation field due to permanent shielding, low activity or give off non-penetrating radiations (alpha or low-energy beta), completion of the Area Survey Record is unnecessary. In these cases, radiation safety is assured through routine leakage testing and inventory taking to assure security of sources.

For persons using sealed sources (except as above), high-energy beta and gamma radiation fields need to be measured and recorded in mr/hr.

For persons using unsealed sources, sources in a dispersible physical state such as solid, liquid or gas and give off non-penetrating radiations only (alpha or low-energy beta), representative samples of all potentially contaminated areas must be wiped with filter paper or equivalent and results recorded in dpm removable.

For persons using unsealed or sealed sources which give off penetrating X, high-energy beta or gamma radiations, all radiation fields need to be measured and recorded in mr/hr. Additionally, representative samples of all potentially contaminated areas must be wiped with filter paper or equivalent and results recorded in dpm removable.

*3. How to calculate dpm removable (dpm = disintegrations per minute).

*4.

* Please refer to sample form following these instructions.

*5. The decay of individual atoms of a radionuclide is subject to the laws of probability. Basic statistics reveal that the distribution of random events can be approximated as the Poisson distribution. The standard deviation of an observed number of counts N is

One standard deviation from the mean represents a confidence level of 68%, while 2 standard deviations represent a confidence level of 95%.

Hence, the net sample rate, NSR, is as follows:

NSR = GROSS SAMPLE RATE (GSR) - BACKGROUND RATE (BR)

The standard deviation of the net sample is

For example, if GSR = 530 counts in 10 minutes and the background count is 50 CPM; at the 95% confidence level, is the sample radioactive?

The net sample is 53 and the background sample rate is 50. The difference is less than 6.4, hence there is no detectable radioactivity in the sample.

If the net sample rate is greater than 2 standard deviations, then calculate DPM.

DPM = CPM x efficiency factor.

$$= \frac{\text{CPM}}{\text{efficiency}}$$

Is your counting system 10, 20, 50, or 100% efficient? You must determine the counting efficiency for each radionuclide for each counting system experimentally.

*6. Re-Test Data

All radiation fields in the laboratory must be reduced to as low as reasonably achievable (ALARA) using shielding, or other methods.

All removable contamination must be reduced to background levels in all areas that are not clearly posted, "CAUTION RADIOACTIVE MATERIALS", such as absorbent paper on benches.

*7. Principal Investigator

Regardless of who in the lab conducts the Area Survey, all results must be approved by the Principal Investigator at the end of each workday on which radioactive materials are used.

*8. Laboratory/Area Diagram

A crude but accurate diagram must be made of all areas in which radioactive materials or radiation sources are used. For large or complex areas more than one Area Survey Record form may be used. For example, if there are more than 11 areas to be surveyed in any given area, more than one sheet must be used.

APPENDIX C

NORTHEASTERN UNIVERSITY

RADIATION SAFETY OFFICE

BIOASSAY PROGRAM FOR INTERNAL RADIATION MONITORING

I. General

Appropriate internal radiation monitoring shall be conducted on any individual working with unsealed radioactive materials where a potential exists for receiving radiation doses and/or body burdens in excess of the limits established in 10 CFR 20. All records of such bioassays will be maintained by the Radiation Safety Office.

II. Iodine-125 and Iodine-131 In-vivo Thyroid Counting

A. All individuals routinely working with greater than 1 millicurie quantities of iodine-125 and iodine-131 shall participate in the in-vivo thyroid counting program conducted by the Radiation Safety Office.

B. The Radiation Safety Office will arrange for routine monthly thyroid measurements for persons exposed as in (A) above. If the quantity handled exceeds 10 mCi, measurements will be performed weekly.

C. In addition to routine monthly thyroid monitoring, personnel involved in so-called "iodination" procedures will receive thyroid measurement preferably within 48 hours of performing the iodination procedure but in any case within one work-week.

D. The maximum permissible weekly increase of iodine-125 or iodine-131 in the thyroid is established as 0.05 microcurie based upon the 40 hour per week maximum permissible air concentration.

E. If a thyroid measurement indicates the presence of greater than 25% of the maximum permissible burden of either iodine-125 or iodine-131 in the thyroid, the Radiation Safety Office shall initiate an immediate investigation of the work place, local exhaust system, work practices, procedures, etc. to determine the cause of the increased iodine uptake. The investigation may include area and personal air monitoring and wipe testing of surfaces as well as visual observation of techniques. Depending on the actual thyroid level of radioiodine, the individual may also be temporarily restricted from further radioiodine work.

III. Phosphorus-32 and Hydrogen-3 Urinalysis

A. All individuals routinely working with unsealed quantities of P-32 or H-3 in excess of 10 mCi will participate in the urinalysis program conducted by the Radiation Safety Office.

B. The Radiation Safety Office will arrange for routine monthly urinalysis on all such individuals. Should the quantity handled by any individual exceed 100 mCi of either radionuclide, the urinalysis frequency shall be increased to weekly.

C. As with the radioiodine bioassy program, if radioassay indicates the presence of greater than 25% of the urinary MPC, the Radiation Safety Office will initiate an immediate investigation of the work place, local exhaust system, work practices, procedures, etc., to determine the cause of increased H-3 or P-32 uptake. Where appropriate, air samples and wipe tests of surfaces will be taken. Depending on the actual level of H-3 and/or P-32 in the urine, the individual may also be temporarily restricted from further exposure.

APPENDIX E

NORTHEASTERN UNIVERSITY

RADIATION SAFETY OFFICE

SAFE HANDLING OF SEALED SOURCES OF IONIZING RADIATION AT N.U.

I. Sealed sources containing licensed material shall not be opened.

II. Gas chromatography detector cells

   A. In lieu of using the conventional radiation caution colors (magenta or purple on yellow background) as provided in Section 20.203 (a) (1), Title 10, Code of Federal Regulations, Part 20, the licensee is hereby authorized to label detector cells and cell baths, containing licensed material and used in gas chromatography devices, with conspicuously etched or stamped radiation caution symbols without a color requirement.

   B. Detector cells containing titanium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents foil temperatures from exceeding 225 degrees Centigrade.

   C. Detector cells containing scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents foil temperatures from exceeding 325 degrees Centigrade.

III. Each sealed source containing licensed material, other than Hydrogen 3, with a half-life greater than thirty days and in any form other than gas shall be tested for leakage and/or contamination at intervals not to exceed six months except that each source designed for the purpose of emitting alpha particles shall be tested at intervals not to exceed three months.

IV. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to use or transfer as a sealed source. If the inspection or test reveals any construction defects or 0.005 microcurie or greater contamination, the source shall not be used or transferred as a sealed source until it has been repaired, decontaminated and retested.

V. A. Each sealed source acquired from another person and containing licensed material, other than Hydrogen 3, with a half-life greater than thirty days and in any form other than gas shall be tested for contamination and/or leakage

prior to use. In the absence of a certificate from a transfer, a sealed source received from another person shall not be put into use until tested.

B. Notwithstanding the periodic leak test required by this condition, any licensed sealed source is exempt from such leak tests when the source contains 100 microcuries or less of beta and/or gamma emitting material or 10 microcuries or less of alpha emitting material.

C. Except for alpha sources, the periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources that excepted from the this test shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within six months prior to the date of use or transfer.

VI. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. The test sample shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently or semi-permanently mounted or stored on which one might expect contamination to accumulate. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.

VII. If the test required by Subsection A. or C. of this condition reveals the presence of 0.005 microcurie or more of removeable contamination, the licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with Commission regulations. A report shall be filed within 5 days of the test with the U.S. Nuclear Regulatory Commission, Region 1, 631 Park Avenue, King of Prussia, Pennsylvania 19406, describing the equipment involved, the test results, and the corrective action taken.

APPENDIX F

NORTHEASTERN UNIVERSITY

RADIATION SAFETY OFFICE

CONDITIONS FOR THE USE OF ANIMALS CONTAINING RADIOACTIVE MATERIALS

I. In addition to approval from the N.U. Radiation Safety Committee, Principal Investigator must possess concurrent approval to use animals from the N.U. Animal Care Committee prior to administering radioactive materials to animals.

II. Protective gloves and a lab coat shall be worn when injecting radioactive materials and when handling animals containing unsealed radioactive materials.

III. Animals containing radioactive materials shall be sacrificed and dissected on trays covered with absorbent material or other approved devices to control the spread of radioactive contamination.

IV. Animals which have been injected or implanted with radioactive materials shall be maintained in areas approved by the Office of Environmental Health and Safety for such work.

V. Metabolic cages or other appropriate restraints such as cage covers shall be used to control the generation of airborne or area contamination.

VI. All cages housing animals injected with radioactive material shall be clearly posted with a properly completed radioactive material label containing the following information:

  A. Type of radionuclide.

  Total amount of radioactive material initially in the cage.

  B. Date of injection or implantation.

  C. Name and telephone number of person responsible for animals.

VII. Animals containing radioactive materials may not be kept in the same cage with animals which do not contain radioactive materials.

VIII. All animal excreta which may contain radioactive materials if mixed with bedding shall be disposed of in an approved

container as radioactive waste; if the excreta is not mixed with bedding, it may be disposed of into an approved sink or toilet into the sewage system provided it does not exceed the limits posted by the Office of Environmental Health and Safety. Otherwise, it must be mixed with absorbent material and disposed of in an approved container as dry or absorbed liquid radioactive waste.

IX. Animal carcasses and tissues containing radioactivity shall be treated with formaldehyde, doubly wrapped and sealed in thick plastic bags, labelled with a properly completed radioactive material label, and stored in an approved freezer for pickup and final disposal by the Office of Environmental Health and Safety.

NORTHEASTERN UNIVERSITY
OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY
RADIATION SAFETY PROGRAM

AREA SURVEY RECORD

Laboratory Information

Laboratory/Area Diagram (Floorplar

Bldg and Room # ______________________

Principal Investigator ________________

Authorization # ______________________

Radionuclides in Use ______________________

Survey Instruments in Use

____

____

____

MONTH/DAY	Results of Area Survey in mr/hr and dpm Removable	Blank COUNT TIME	RE-TEST DATA	Prncpl. Invstgt

APPENDIX D

NORTHEASTERN UNIVERSITY

RADIATION SAFETY OFFICE

EMERGENCY PROCEDURES

I. MINOR SPILLS

A. NOTIFY: Notify all persons in the area that a spill has occurred.

B. PREVENT THE SPREAD: Cover the spill with absorbent paper.

C. CLEAN UP: Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Also insert into a plastic bag all other contaminated materials such as disposable gloves.

D. SURVEY: With a low-range, thin-window G-M survey meter, check the area around the spill, hands, and clothing for contamination.

E. REPORT: Report incident to the Radiation Safety Officer.

MAJOR SPILLS

A. CLEAR THE AREA: Notify all persons not involved in the spill to vacate the room.

B. PREVENT THE SPREAD: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.

C. SHIELD THE SOURCE: If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.

D. CLOSE THE ROOM: Leave the room and lock the door(s) to prevent entry.

E. PERSONNEL CONTAMINATION: Contaminated clothing should be removed and stored for further evaluation by the Radiation Safety Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

RADIATION SAFETY OFFICER: Philip LaTorre

OFFICE PHONE: x2147 or x2769

HOME PHONE: (508) 475-8639 or request assistance from the Public Safety Division - x2121

ALTERNATE NAMES AND TELEPHONE NUMBERS DESIGNATED BY RADIATION SAFETY OFFICER:

F.X. MASSE ASSOCIATES 283-4888 (24 hour coverage)

Steven Brehio	Office: x2769	Home: (401) 333-0502
Sandra Gogol	Office: x2769	Home: (617) 776-3412
Jack Price	Office: x2769	Home: (617) 327-8627

e. Water Quality

Vanasse Hangen Brustlin, Inc.

Engineers,
Planners,
and
Scientists

VHB

101 Walnut Street
P.O. Box 9151
Watertown, MA 02272
617 924 1770
FAX 617 924 2286

ENVIRONMENTAL PROTECTION

Water Quality

a. Three permits will be required to discharge the effluent generated by this project:

1) A Sewer Use Discharge Permit from the Massachusetts Water Resources Authority (MWRA) and

2) A Permit for Sewer System Extension or Connection from Department of Environmental Protection (DEP).

3) An Industrial Sewer Connection Permit from the DEP.

(Note: It is our understanding that biological and chemical characteristics of the waste and the proposed pretreatment system will be discussed by others.)

These permits are initiated through Boston Water & Sewer Commission (BWSC).

b. The proposed stormwater collection system will continue to discharge into the existing system for the site. This system connects to a separate BWSC stormwater drainage system on Camden Street. Due to the proposed reduction of flow rates, volumes and contaminants, this discharge should be covered under the BWSC NPDES Permit.

The construction project will not disturb five acres of land. Therefore, a NPDES Construction Permit should not be required.

Cosentini Associates
Consulting Engineers

44 Brattle Street
Cambridge, MA [illegible]

Fax [illegible]

Telephone [illegible]

Cosentini
ASSOCIATES

Partners
M. A. Mass, PE
J. Nelson, PE
D. Mazur, PE
R. P. Leber, PE
D. C. Mass, PE
J. Michael, PE
S. A. Quan, PE

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MAR 31 1993
Proj. No. 881.00
File Category 4.0

December 30, 1992

Cannon - Boston
148 State Street
Boston, MA 02109

Attention: Garrick Niemiec

Reference: Northeastern University
Engineering Science Center (ESC.)
Our Job No. 0258
Water Quality

Gentlemen:

Responding to information requested on the: Draft-Project Impact Report.

We provide the following comments:

I. Chemical Use:

A. The proposed list of chemicals will/must be provided by Northeastern University Department of Environmental Health and Safety.

B. Small quantities of various chemicals and other materials will be used for research and instruction in the ESC. Northeastern University has long-standing practice of careful management of potentially hazardous materials in accordance with applicable laws and regulations, including careful use and handling of materials, detailed record keeping, and documentation of all materials through transportation and disposal at licensed and approved sites. Hazardous wastes generated by the proposed ESC Project will generally be comprised of the types and quantities of chemical, biological and radiological wastes typically associated with University research laboratories. Transportation and disposal of any hazardous materials generated or used in connection with the operation of the Project will be conducted by licensed contractors. Accordingly, significant adverse impacts resulting from the use, storage and disposal of potentially hazardous materials at and from the ESC Project are considered unlikely.

II. Inactivation of Laboratory Waste

A. pH Adjustment Tanks

1.) Where it is inadvisable or impractical to install a neutralizing sump with either marble or limestone chips to bring pH factor of waste materials up to neutral zone or where the pH factor of anticipated wastes may vary from acid range through neutral zone and up into the alkaline range a pH adjustment tank is to be provided.

2.) pH adjustment tanks may be installed for partial or entire building systems.

3.) pH adjustment tanks will consist of an acid/alkaline resisting tank. Receiving wastewater from one (1) or more sinks. The tank is to have an agitator, which will run when serving sinks/cupsinks, etc. are in use. Tank will also have a sensor, to detect the pH of tank contents within a range of 2 (acid) to 12 (alkaline). This sensor is to be electrically connected to a control panel. This control panel is to be connected to acid/alkaline pumps. Acid/alkaline pumps are to be inserted into tanks containing neutralizing agents to bring tank contents up from an acid pH or down from an alkaline pH to a range of 6 to 9. The discharge of each pump is to run directly top H adjustment tank.

4.) The neutralizing tank is to be equipped with a pH system the pH system shall be equipped with an audio-visual alarm and an "outflow" recorded for pH. The alarm and recorder shall function at all times the system is operating.

5.) Solvent bearing waste shall not be introduced into the building drainage system or sewer, but shall be disposed of according to the applicable regulations of the Department of Environmental Protection, Environmental Protection Agency or other appropriate regulating agency.

6.) Acidic wastes shall be neutralized before being discharged into the building's sanitary drainage system.

III. Recombinant D.N.A. Laboratory Wastes

A. Viable organisms containing recombinant DNA (deoxyribonucleic acid) as defined in the NIH guidelines shall not be introduced into the building drainage system or sewers without first being sterilized, treated or inactivated as described below.

B. In laboratories where both fermentation and purification take place, the waste for each shall be treated by methods proven to be effective and appropriate for the specific type of waste (as required by Massachusetts Law, 310 CMR 30.000: Massachusetts Hazardous Waste Regulations and Water Resource Commission, Regulation of Waste into Sewerage Works) prior to their discharge into the building's drainage system or sewer.

C. Laboratory wastes, generated by research laboratories, which contain viable recombinant DNA organisms shall be sterilized or treated according to the regulations and standards of the National Institute of Health (Recombinant DNA Guidelines and the Laboratory Safety Monograph) or the applicable requirement of other agencies having jurisdiction. The owner of the laboratory shall submit the proposed treatment procedures to the registered professional engineer who prepares the plans and specifications of the special waste system and to the relevant authorities and received their approval prior to connection to the building's drainage system.

D. Waste containing recombinant DNA organisms shall be sterilized or treated at the point of origin, where there is more than one point of origin, these astes may be collected in a central holding tank for sterilization and treatment. This holding tank is to have a sampling device and a high water alarm. The alarm shall be activated when the tank's contents have reached a predetermined level. The sampling device is to consist of a pump or other device or means to transfer a selected sample into the control area of the laboratory for verification that it contains no living organism. When the sample contains no living organisms, the contents of the tank can be allowed to enter the sewer system. If live cells are discovered by the sampling process, the contents of the tank shall be resterilized and retested before being allowed to enter into the sewer. See reference cited below concerning "steam sterilization" and chemical disinfection.

E. The adequacy of treatment methods as selected by an institution is to be monitored on a periodic basis. Research laboratories shall maintain records indicating the results of such testing. In the event of a testing failure, the system is to be corrected immediately.

F. Neutralizing chambers or tanks employing marble or limestone chips shall not be used to adjust ph for wastes generated by biochemical research or production laboratories.

G. Approved and recommended references for "steam sterilization" and"chemical disinfection".

1) Laboratory Safety Monograph (A supplement to the NIH Guidelines of Health and Human Services Section 11-E-8, Selecting Chemical Disinfectants in Recombinant DNA Research, 102-105.

2) Disinfection, Sterilization and Preservation 3rd Ed. Edited S. S. Bock, Lea and Febiger, Philadelphia, 1983. (Part 1 Chemical and Physical Sterilization, Chapter 1 Sterilization by Heat.)

Cordially,

Frank G Teebagy

Frank Teebagy, P.E.
Senior Associate

cc: Dick Leber
Bob Leber
Randy Duke

f. Noise

Northeastern University
proposed
Engineering Science Center

Vibration Studies

Draft

March 10, 1992

Cavanaugh Tocci Associates, Inc.

Sudbury, Massachusetts

General Observations and Conclusions

There are three central categories of vibration recommendations required in this study. The first regards the structural design of the building. This pertains to those aspects of the building design needed to minimize its susceptibility to excitation by Southwest Corridor activity, footfall within the building, and building mechanical equipment.

The second category pertains to the development of recommendations for the control of vibration produced by building mechanical equipment. Unlike the first category which viewed vibration from the standpoint of building structural design, this second category deals with vibration isolation of mechanical equipment. The primary aspect of vibration isolation is isolator static deflection, i.e., the amount by which an isolator is compressed under the dead load of the machine supported.

The third category pertains to the development of general recommendations for vibration isolating sensitive laboratory instrumentation. It is our experience that most vibration problems in laboratories are associated with vibration produced by research service equipment such as compressors, pumps, and vacuum pumps. In this particular case, only general recommendations can be provided since it is not known what specific equipment items are expected to used in this facility at this time. Nevertheless, researchers should have clear guidelines on what they should expect with respect to vibration in the new building and what precautions they should expect to take in installing their own equipment.

Building Structural Design

Recommendations for building structural design focus on optimizing stiffness, damping, and mass, while being attentive to cost considerations. At first glance, a complete reinforced concrete building would appear to be the best alternative from the standpoint of vibration. Such buildings, however, usually lack the structural connection mechanisms between floors and structural steel that produce damping by slippage. Attempting to overcome this by making the building even more massive can be unfeasible. Hence, unless massive enough, cast concrete building structures often do not offer any special advantage in controlling vibration.

Lightweight stiff buildings can be designed to have very high floor vibration resonances. These typically are steel frame buildings with composite or pinned slabs. The pinning of the slabs to provide greater floor stiffness in a thin cross section leads to an undamped building that can be easily excited because it is light. The low damping allows vibration to build in the structure offsetting the benefit of stiffness.

Characteristics of an optimum building structure are as follows:

- Unpinned slabs to allow slippage between beams and concrete slabs.
- A floor slab design with a smaller deflection criterion than $l/360$.
- Drywall partitions that cross near the center of floor spans.
- Separately structured stair and elevator towers.
- Smoothly finished floors to avoid rolling discontinuities.
- Creation of as many isolated sectors of the building as possible using expansion joints and separate structuring.
- Masonry walls a-roofs to minimize infra sound transmission into building spaces from passing trains. Minimal window area facing the Southwest Corridor.

Building Mechanical Equipment Vibration Isolation

Our general recommendations for the control of vibration from building mechanical equipment in the new Engineering Science Center are as follows:

1) Equipment located in the basement or in a mechanical penthouse mezzanine and outfitted with motors less than 3 horsepower, should be mounted on double-deflection neoprene mounts sized to provide a minimum static deflection of 0.4". Equipment located in the basement or on the mechanical penthouse mezzanine and outfitted with 3 horsepower motors or larger, should be mounted on steel spring isolators sized to provide a minimum static deflection of 1".

2) Equipment located above the basement level and outfitted with motors less than 3 horsepower, should be mounted on steel spring isolators sized to provide a minimum static deflection of 1.5". Equipment located above the basement level and outfitted with 3 horsepower motors or larger, should be mounted on steel spring isolators sized to provide a minimum static deflection of 2".

3) Equipment with motors less than 1 horsepower, no matter where they are located, may be mounted on double-deflection neoprene mounts sized to provide a minimum static deflection of 0.5".

4) Isolators used for water bearing equipment should be height restrained.

5) Isolators used out-of-doors should have metal components coated or treated to

resist weathering, especially in the presence of acid or alkaline exposure, and should be wind sway restrained.

6) Neoprene components of isolators used out-of-doors should use a "bridge-bearing" type neoprene.

7) Seismic restraint of isolated equipment must conform with applicable codes and regulations.

8) Inertia bases are not needed except when mechanical equipment motion (such as that produced by reciprocating compressors) on isolators requires stability, or when shaft alignment between motors and equipment (such as pumps) needs to be maintained by an additional rigid base beyond that provided by the manufacturer of the equipment.

9) All radial blade fans should be substituted with backward incline fans in order to eliminate possible blade passage tones that sometimes result with fans of this type.

10) Locate all large reciprocating equipment at grade level where possible.

Instrumentation Vibration Isolation

Instrumentation vibration isolation is not part of the base building design. Developing specific vibration isolation recommendations would require knowing specific details for equipment to be isolated. As this is a speculative building, such information is not available. Moreover, this building will cater to research activity that will be continually changing. Hence, consideration of vibration isolation of instrumentation will be a continuing and evolving process. However, several general comments can be made:

1) Most instrumentation are susceptible to vibration in the 10 to 20 Hz range. Below this range, instruments (with the exception of those with delicate suspensions) move in a monolithic fashion. Above this range, internal components of instruments are not easily excited. In the 10 to 20 Hz frequency range, internal structural resonances are excited hampering instrumentation operation. Therefore, vibration isolation systems and other mounting systems (including bench mounting) must have suspension resonances either far enough above or below this range.

2) The general rule of thumb is that vibration isolation systems should have a resonant frequency at least 3 octaves below supported equipment resonances. Three octaves corresponds to a factor of 8 (2^3). For the 10 to 20 Hz range mentioned, this means that a maximum suspension resonance of 1.125 Hz is required. Most air isolator devices can provide resonant frequencies down to this

frequency. Conventional steel springs can not general provide the required static deflection. If for a specific instrument, the susceptible frequency range is higher than 10 Hz, a higher suspension resonant frequency can be used which corresponds to a smaller static deflection, many times small enough to be obtained using conventional steel spring isolators.

A steel spring isolator able to meet the isolation criteria at 10 Hz would need to provide a minimum 6.3 inch static deflection. The usual limit for steel spring static deflection is 4 inches. A steel spring sized to achieve a 4 inch static deflection would satisfy the 3 octave band criteria down to 12.5 Hz.

3) Laboratory benches, if properly designed to be stiff, lightweight, and not fitted with massive bench tops, can provide equipment suspension resonances above 20 Hz. This ensures good coupling with the floor without resonant excitation so that bench top vibration levels are no higher than floor vibration levels. This is not true of long bench surfaces supported at the ends by pedestals. Long benches supported by pedestals often have vibration levels higher than floor vibration levels.

4) Safety requires that vibration isolators be installed far enough outboard of the center of gravity of machinery supported to avoid rocking motion or overturing. This is of particular concern with NMRs with magnets mounted on high stanchions.

5) Avoid attaching laboratory benches to walls.

6) Laser benches nearly always need air type isolation supports, even in spaces with low floor vibration.

7) About 75% of the attempts we see to vibration isolate instruments either do not help or increase instrument vibration exposure. Among these are:

   - Placing instruments on heavy bases which are then supported by light weight, insufficiently braced frames

   - Placing instruments on pad or other resilient materials which are either overloaded, crushing them stiff, or under loaded resulting in little or no static deflection.

   - Locating insufficiently isolated or un-isolated vibration producers (e.g. vacuum pumps, compressors, refrigeration units) too close to sensitive instrumentation.

g. Construction Impacts

ENGINEERING SCIENCE CENTER
CONSTRUCTIONS IMPACTS

1. Dust and Pollutant Emissions

Excavated site materials will be the principal source of dust. Northeastern University will require the general contractor to utilize methods such as surface wetting of materials and covering of stored materials to minimize the impacts of dust and to maintain the site in the cleanest state practicable.

2. Noise

The University will intensively manage the construction process so that construction noise will be kept to a minimum. This is due primarily to the fact that the three adjacent structures to the site are teaching facilities or libraries. Excessive noise would adversely impact the quality of the teaching environment in the area.

3. Staging Areas and Parking

Construction staging will primarily be located within the construction site. Adjacent areas might also be put to use for short term storage of materials such as precast concrete panel staging. Secure site fencing will isolate the staging area/construction area from adjacent university and public space. No on-site parking will be specifically reserved for construction worker's vehicles. As a matter of policy, the University strongly encourages the use of public transportation by the general contractor and its work force.

4. Construction Schedule, Work Hours and Access

At this time, a detailed construction schedule cannot be produced. It is expected that the duration of the construction will be eighteen (18) months. The normal work day will begin at 7:00 am and end at 6:00 pm. The work force will vary greatly during the construction period depending on such variables as schedule and weather. During the anticipated 18 month construction period, the average daily work force will range from 40 to 50 individuals. As the project nears completion, an increase in the daily work force would be expected for a limited period of 1 to 2 months.

5. Access Route and Volume of Construction Vehicles

The primary access route to the site will be Forsyth Street. The secondary access route will be the Gainsborough Street/St. Botolph Street entrance to the campus. It is anticipated that a minimum number of vehicles servicing the general contractor, perhaps 3 to 5, will be on the construction site. During the construction period, delivery related vehicle activity will account for approximately 20 vehicle trips per day, with an increase to 40 trips during the peak construction period in months 9 through 12.

6. Debris Disposal

Construction waste and excavate will be disposed of in accordance will all applicable municipal, state and federal laws, regulations and ordinances. If possible in terms of schedule, bituminous paving excavated from the site could be recycled.

7. Rodent Control

Northeastern University intends to engage a reputable rodent control firm, as it has done in the past, to perform the task of on-going rodent control during the construction process.

8. Pedestrian Safety

This project will enhance the pedestrian environment surrounding the project site, as well as the campus in general. During construction, the site will be securely fenced with locked gates. Pedestrian movement will be accommodated on the sidewalks adjacent to the site. The building access and landscaping improvements in the vicinity of the site will be designed to coordinate with surrounding uses and structures, thus improving the overall pedestrian environment.

4. URBAN DESIGN

a. Program Elements

b. Context Plan

c. Photographs Of Site And Neighborhood

d. Master Plan

e. Perspective

f. Aerial Views

g. Site Sections

h. Site Survey

i. Site Plans

j. Building Plans

k. Building Elevations

l. Building Sections

a. Program Elements

PROGRAM ELEMENTS - SPACE ALLOCATION

This section describes the specific requirements included in this project.

The basis of the design is to develop a generic research facility with multidisciplinary laboratories and support spaces capable of accommodating the broad range or research activities projected for Northeastern University.

The following is a summary of the net assignable space projected for this project.

SPACE SUMMARY	NASF
Laboratory/Lab support/Lab office	46,976
Lab floor core facilities - 4 @ 1250 nasf	5,000
Building Support - (Basement Level)	4,750
Technology Transfer Center (Conference)	2,000
TOTAL NET ASSIGNABLE AREA	**60,726**

Overall building efficiency (excluding tunnel connection) is projected at approximately 60%.

THE FOLLOWING IS A DETAILED BREAKDOWN OF SPACE PROPOSED FOR THE NEW ENGINEERING SCIENCE CENTER:

Typical Laboratory Floor

Each typical lab floor provides 40 typical laboratory modules. Individual laboratories are developed by combining modules in response to specific needs. The following is a typical space program for each typical laboratory floor. Individual floors will be modified to accommodate specific user groups when occupancies are identified.

SPACE TYPE	NASF	#RMS	TOTAL
LABORATORY	252	30	7,560
SUPPORT MODULES - Large	252	10	2,520
SUPPORT MODULES - Small	115	10	1,150
OFFICES/WORKSTATION MODULES	115	30	3,450

Typical Laboratory Floor (cont'd)

SPACE TYPE	NASF	#RMS	TOTAL
CORE FACILITIES			
CONFERENCE ROOM	400	1	400
CONFERENCE ROOM	200	1	200
BREAK AREA	250	1	250
COFFEE STATION	100	1	100
CLERICAL AREA	150	1	150
COPIER STATION	100	1	100
CLERICAL SUPPLIES	50	1	50
TOTAL NASF PER TYPICAL FLOOR			**15,930**

In addition to the above net assignable areas on each typical floor, the following functions need to be provided:

COMMUNICATIONS CLOSET - 100 NASF

JANITOR CLOSET - 40 NASF

JANITOR/HOUSEKEEPING STORAGE ROOM - 80 NASF

These areas support each typical floor and are part of the gross square footage for this building.

Specific laboratory to laboratory support space ratios will vary depending upon assigned occupancy. In general, lab to lab support will vary between 2:1 and 3:1. Both lab and lab support space will be located in the typical modules, eliminating the need for custom space. This will also enhance the potential to reallocate space over time as needs warrant.

On individual floors, the specific distribution of laboratory and support space can be in response to specific research requirements. Certain support functions should be provided an each typical floor (i.e., glasswash, coldrooms), while research support can be in response to individual needs

Basement Level Support Functions

The basement level of the new building will be connected to the existing basement level of the Dana/Snell building. The functions to be located on this level include laboratories for sensitive instrumentation, building support functions, and mechanical/electrical areas.

The Engineering Science Center basement level research and support functions will include:

SPACE TYPE	NASF	#RMS	TOTAL
Laboratory Modules - (vibration sen. eq.)	367	8	2936
Laboratory General Storage	3000	1	3000
Hazardous Waste Holding	200	1	200
Cylinder Storage (oxidizer & non-oxidizer)	200	2	400
Equipment Storage	500	1	500
Connector to Dana/Shell	2000	1	2000
Loading Dock (2 docks)	135	2	270
Receiving Area	250	1	250
TOTAL NASF			**9,556**

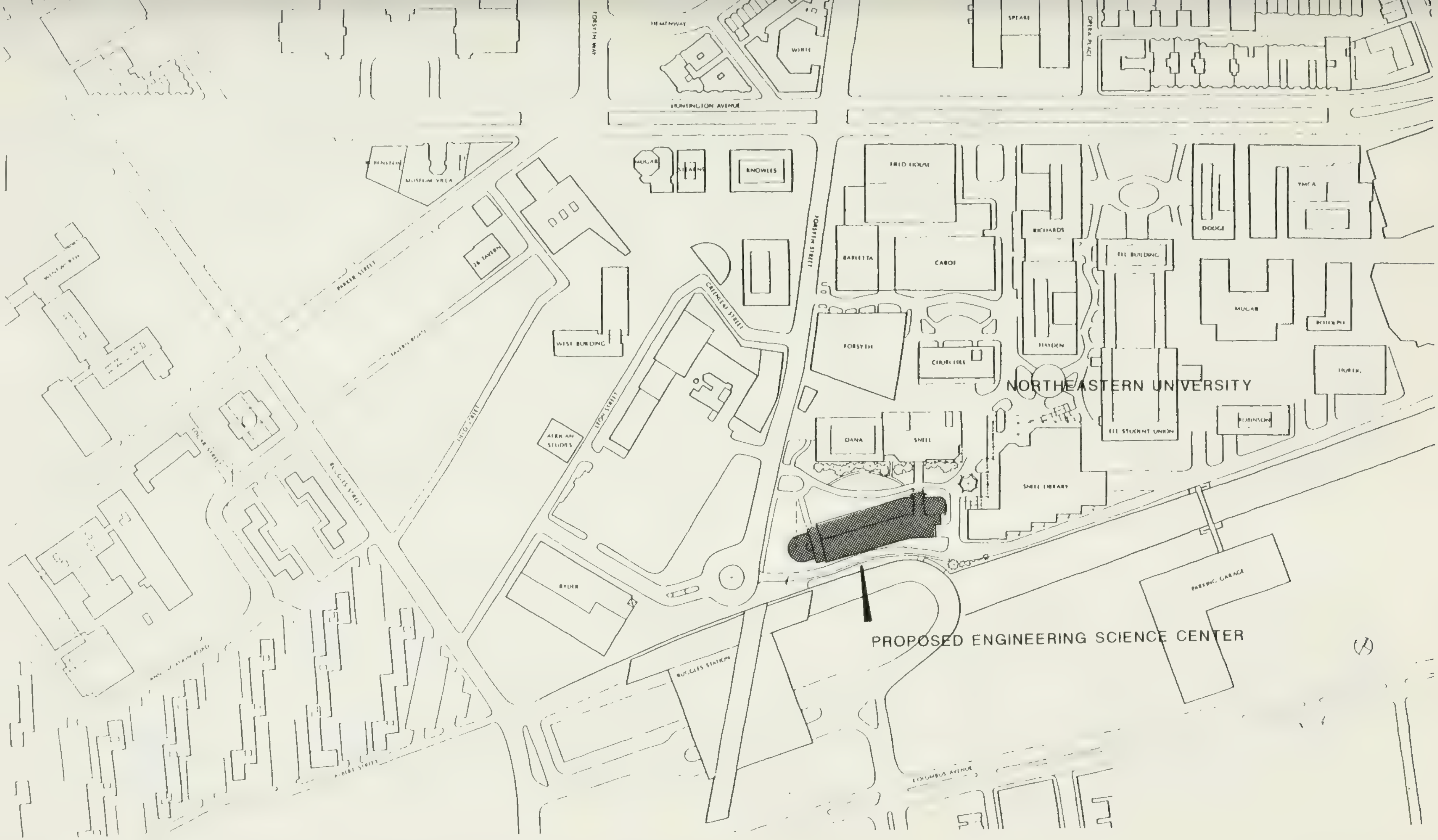
Typical Floor Support Functions

The following typical support functions will be developed on as needed basis when specific occupancies are determined:

Glasswash
Shared equipment rooms
Coldrooms
Storage
Darkroom
Hot Lab
Isolation Rooms
Computer Rooms

Specific support determinations for the initial construction and fitout will be made during the design phase of the project.

b. Context Plan

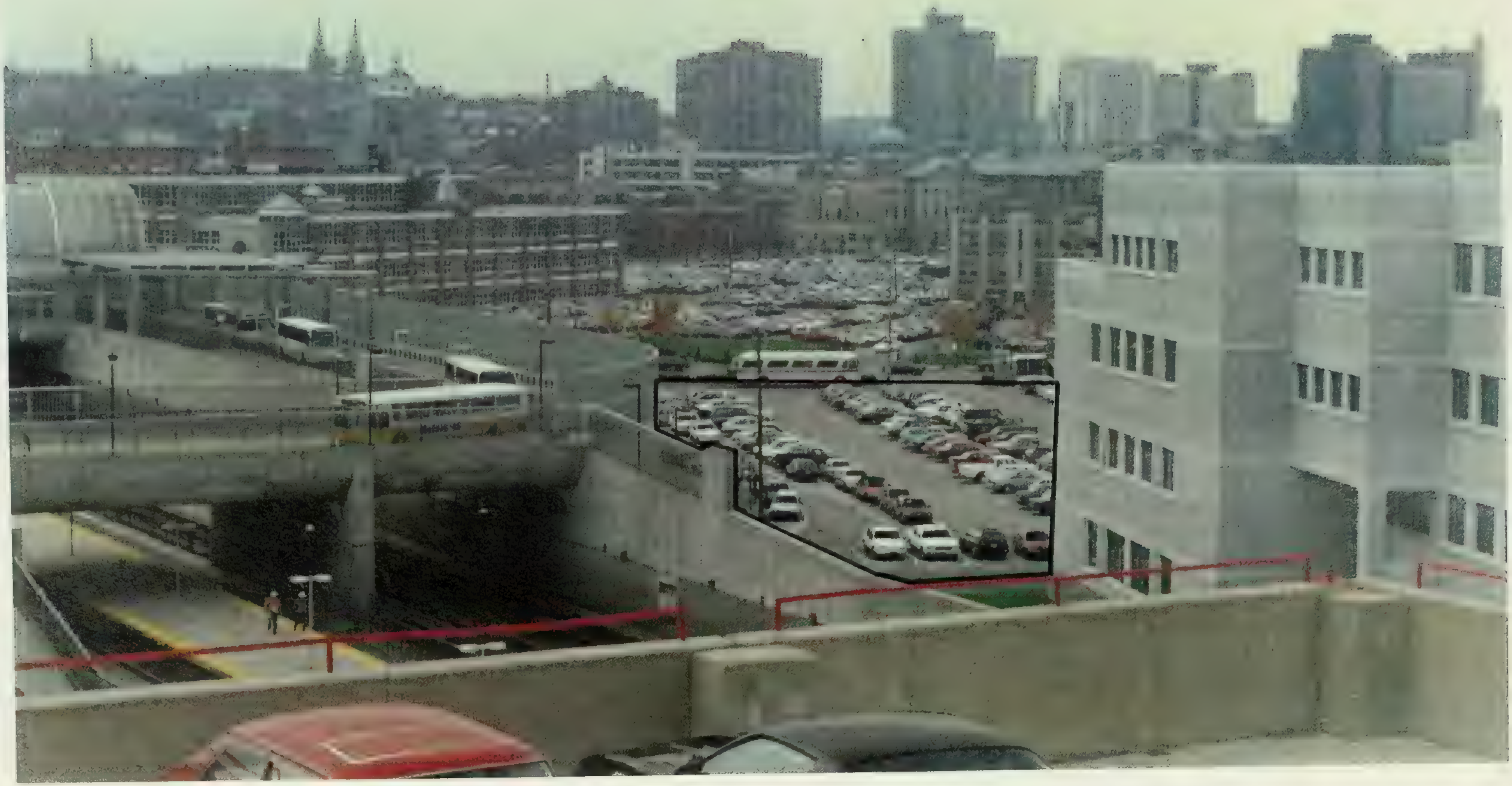


NORTHEASTERN UNIVERSITY

ENGINEERING SCIENCE CENTER

CANNON

c. Photographs Of Site And Neighborhood



View toward West; MBTA Ruggles Station on the left, Snell Library on the right.

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ENGINEERING SCIENCE CENTER

CANNON

View toward West; Ruggles Station on the left, Ryder Building in the background.

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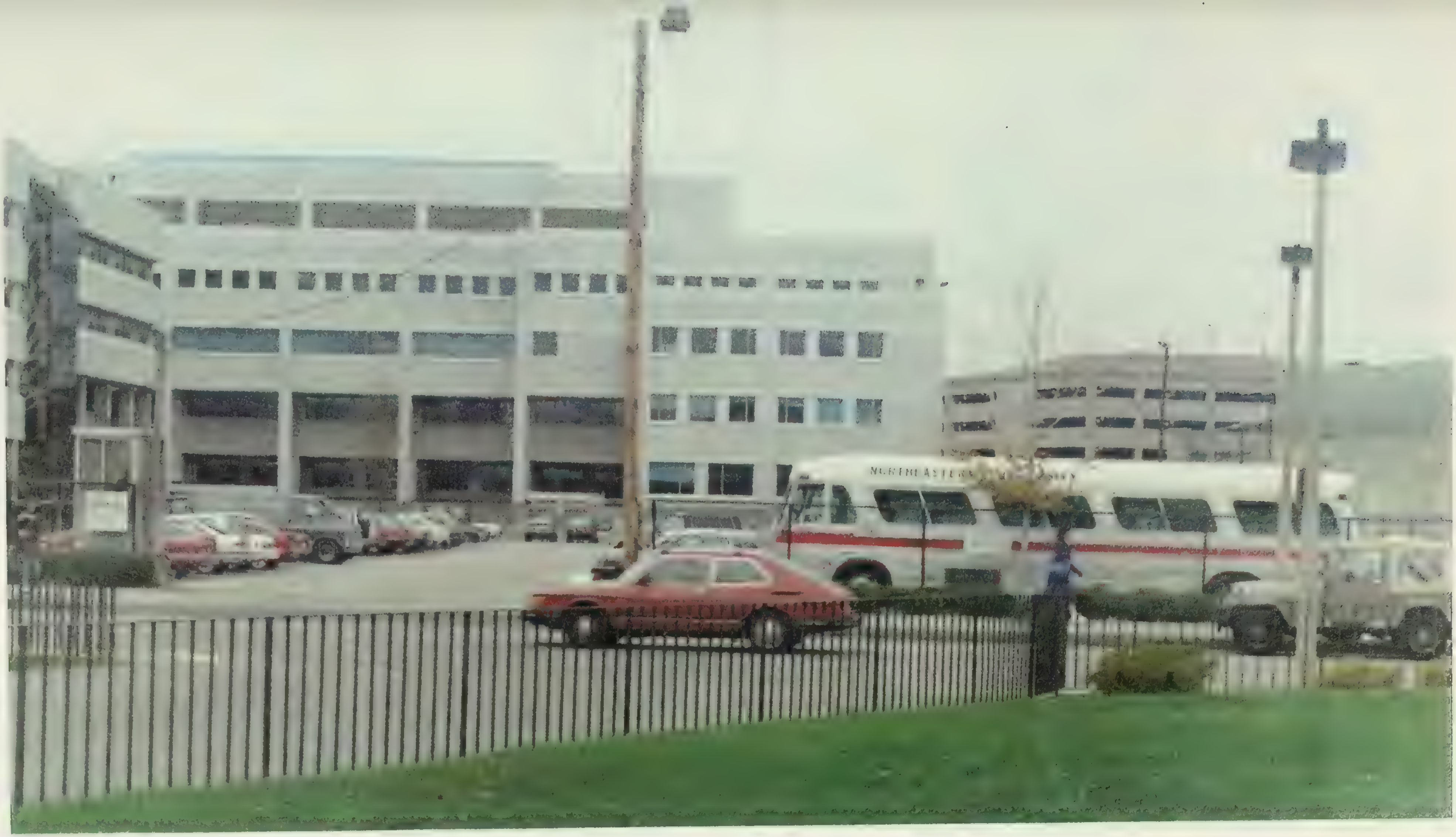

View toward East; Snell Library in the Background, Forsyth St. in the front.

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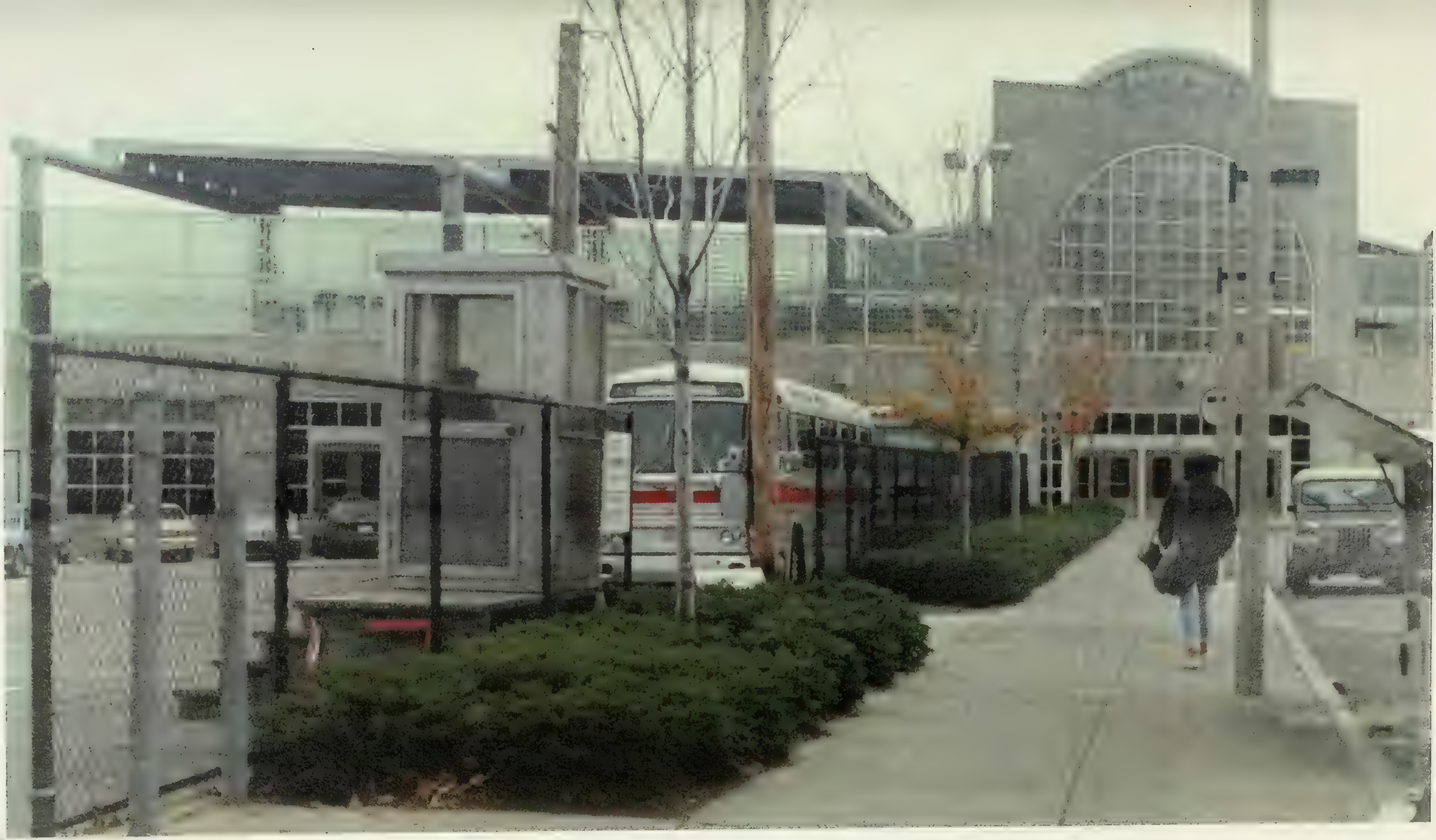

View along Forsyth St. toward Ruggles Station.

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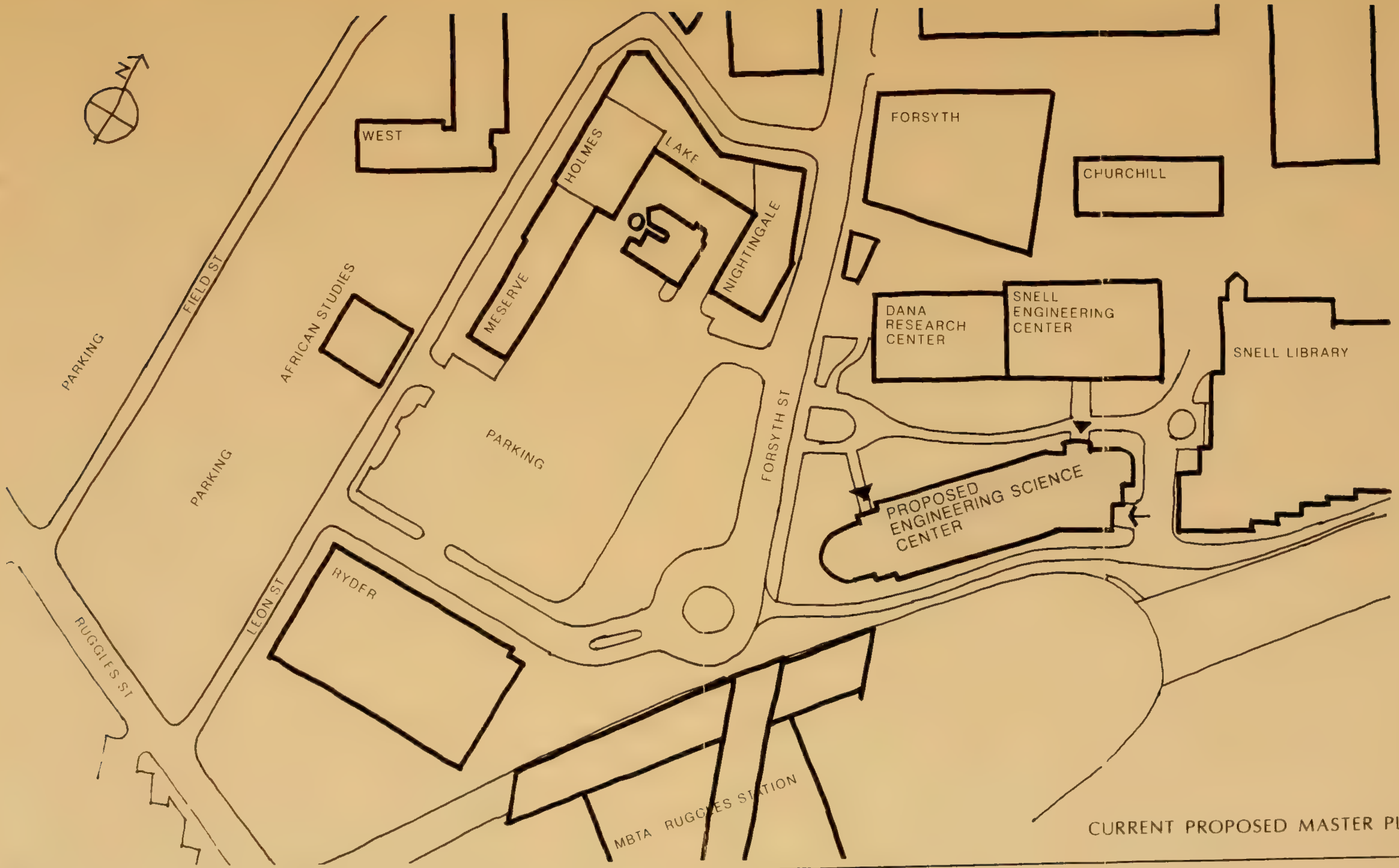
d. Master Plan



CURRENT PROPOSED MASTER PLAN

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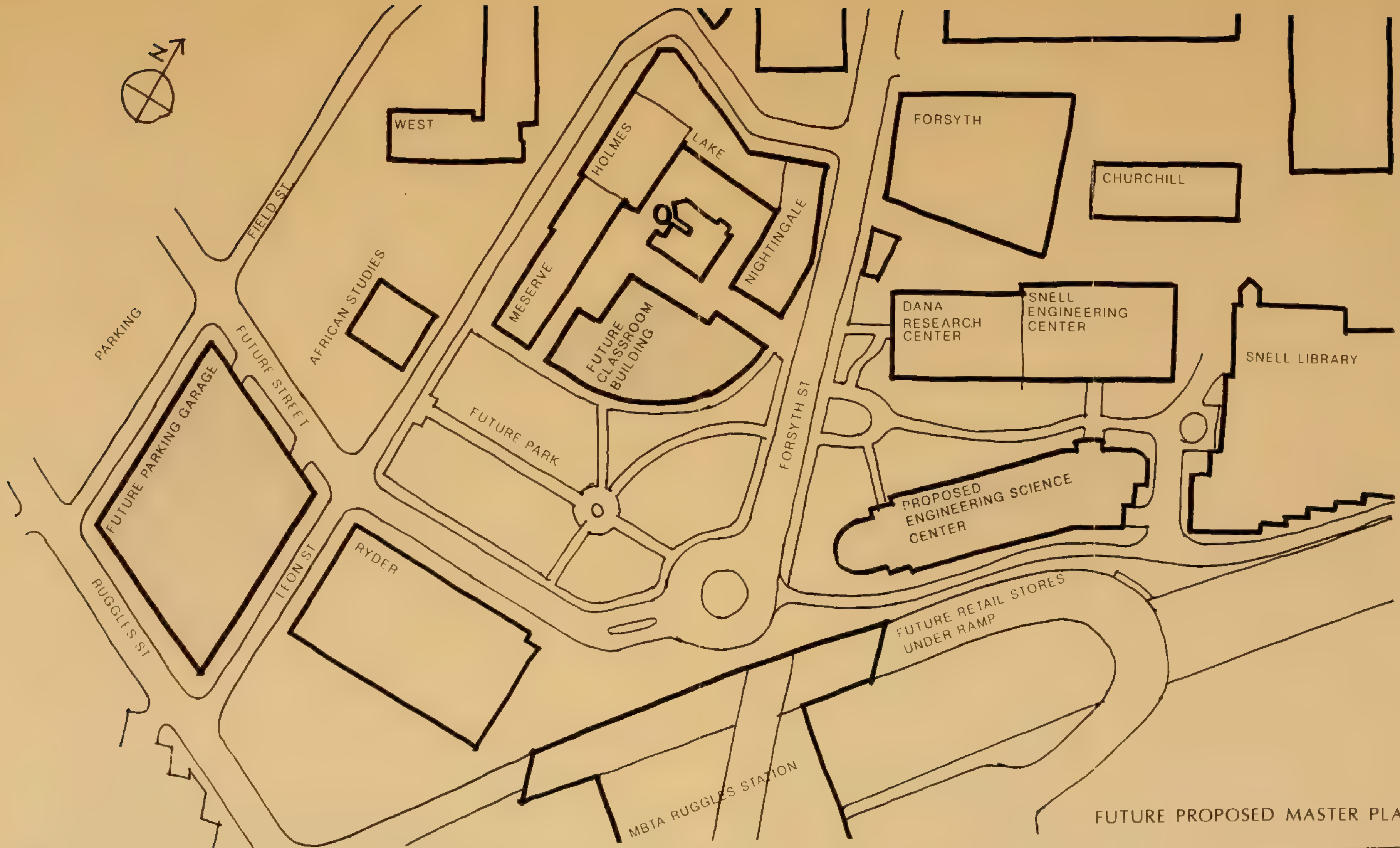

FUTURE PROPOSED MASTER PLAN

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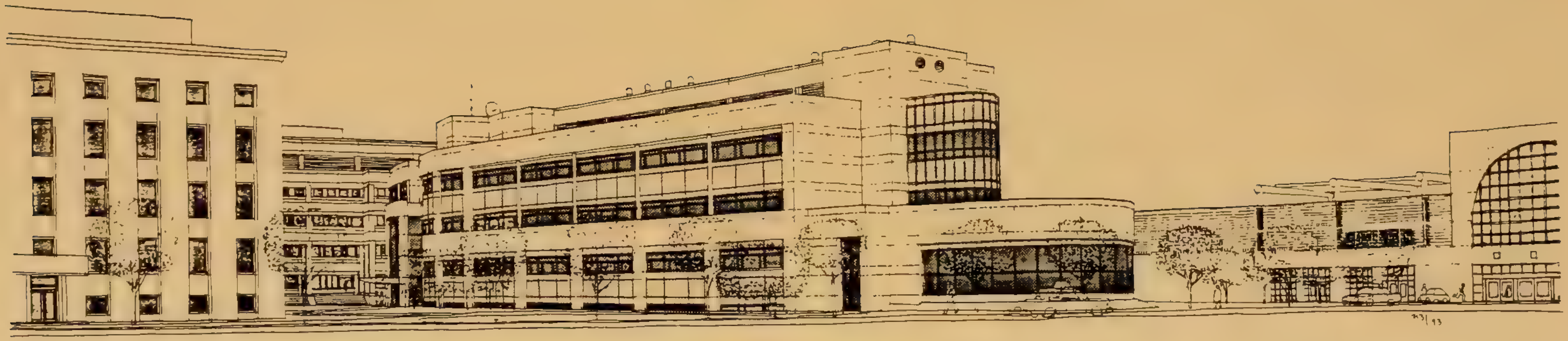
e. Perspective



VIEW ALONG FORSYTH STREET

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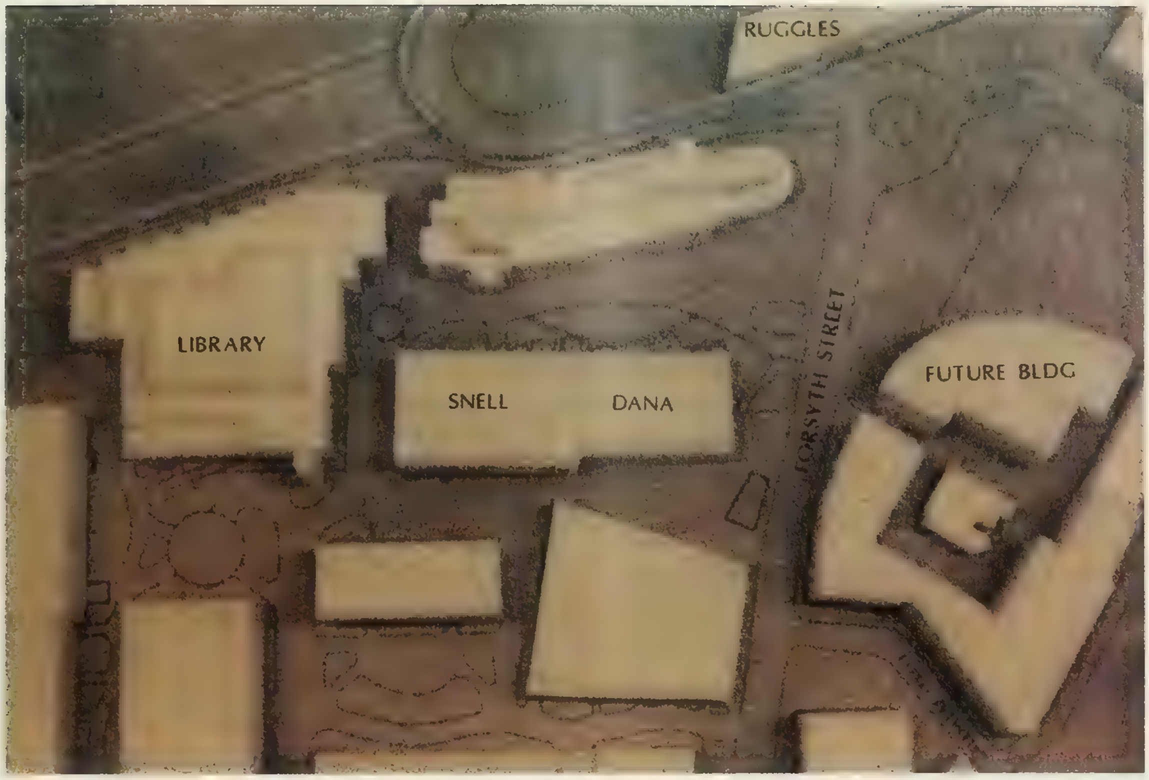
CANNON

f. Aerial Views



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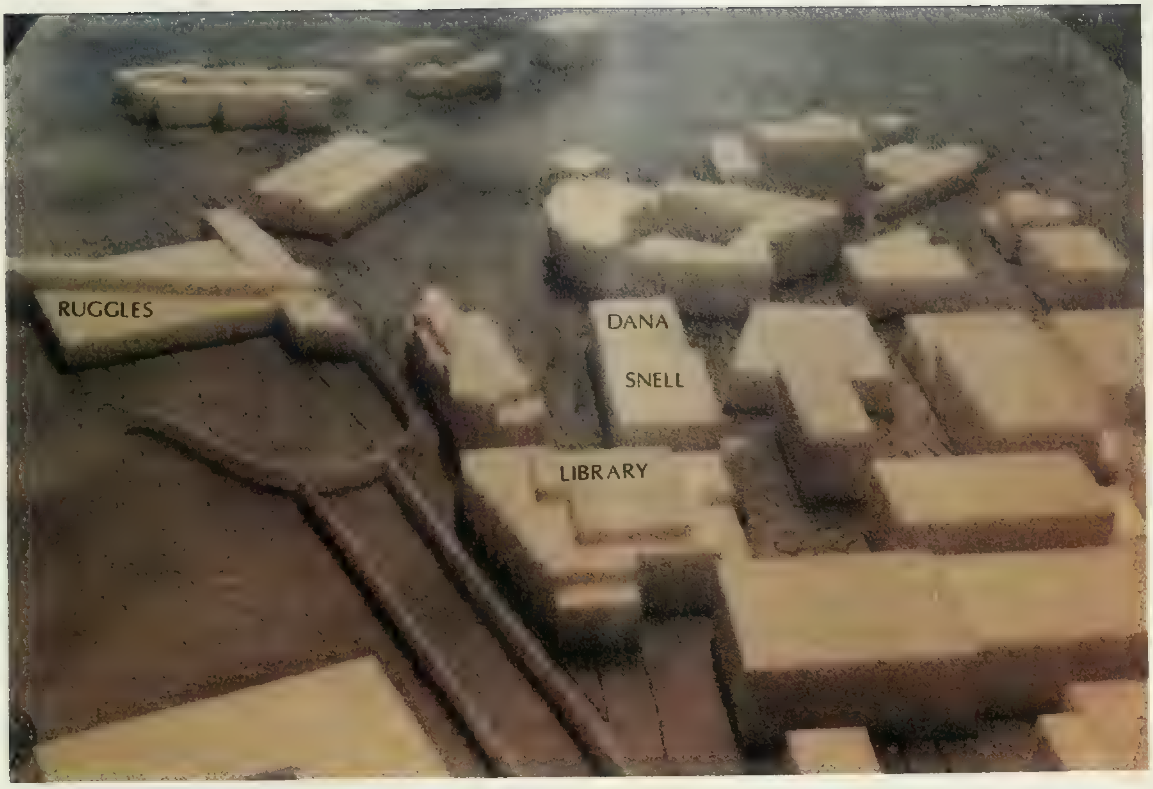

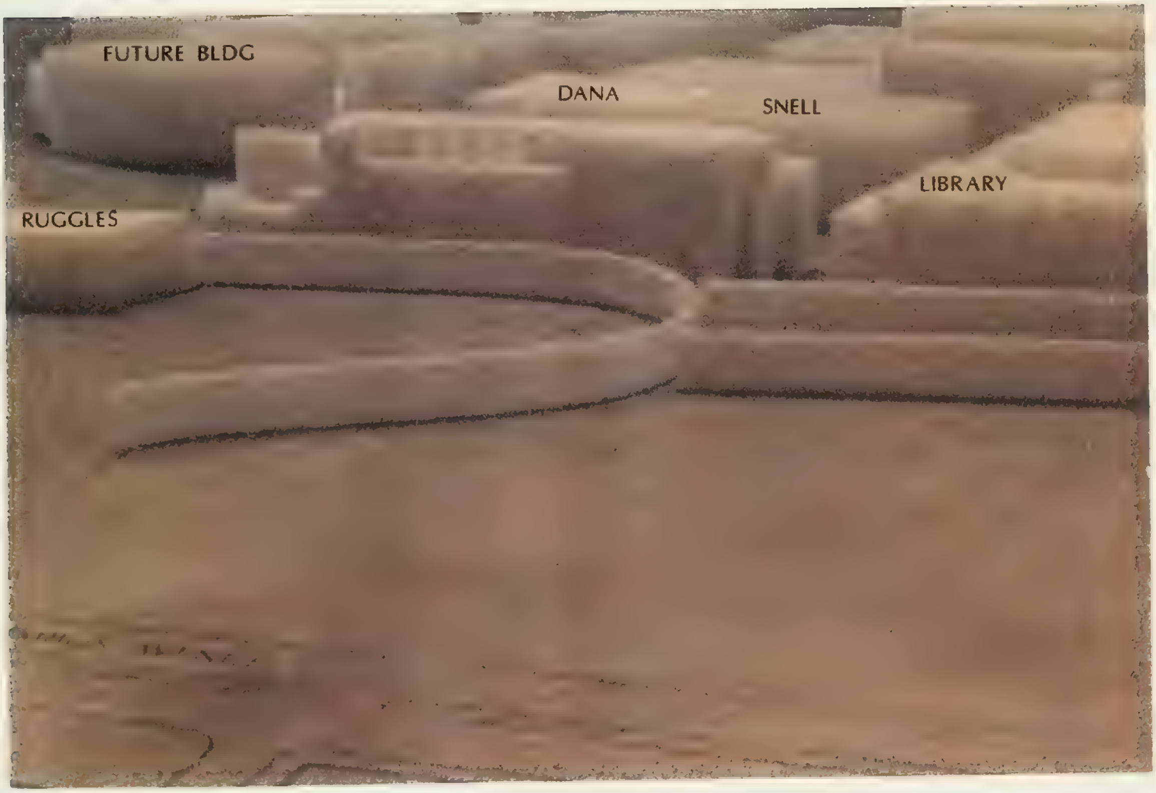

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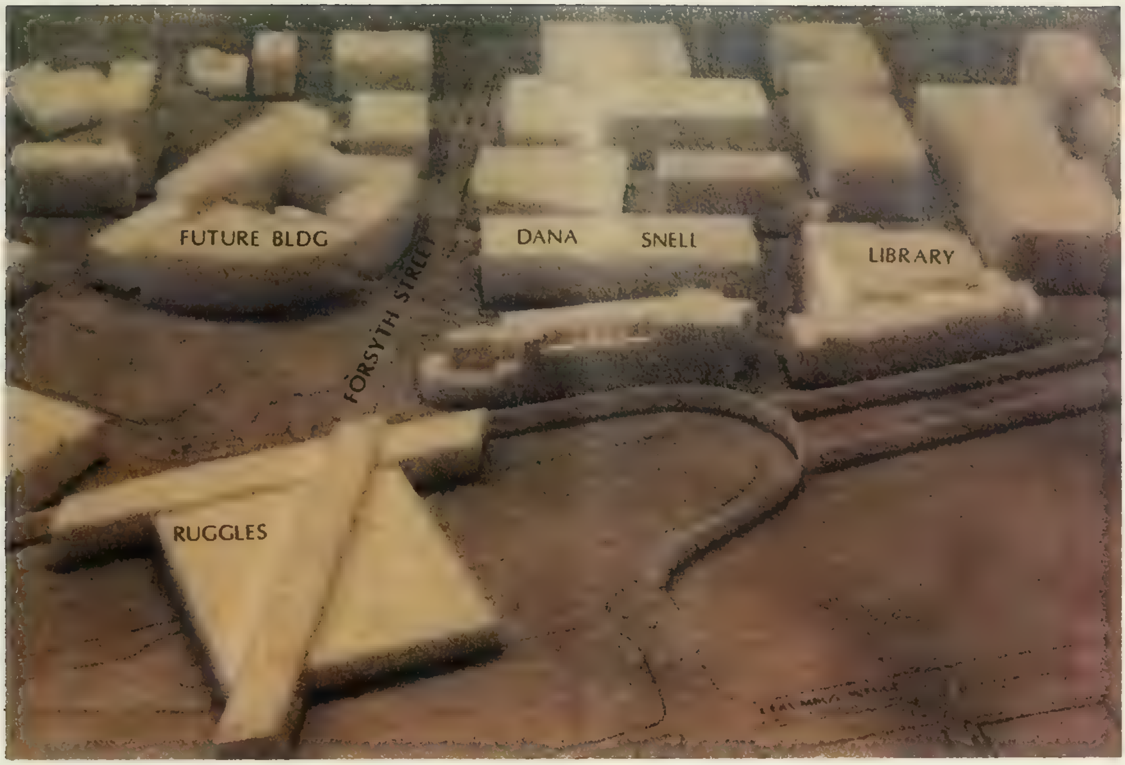
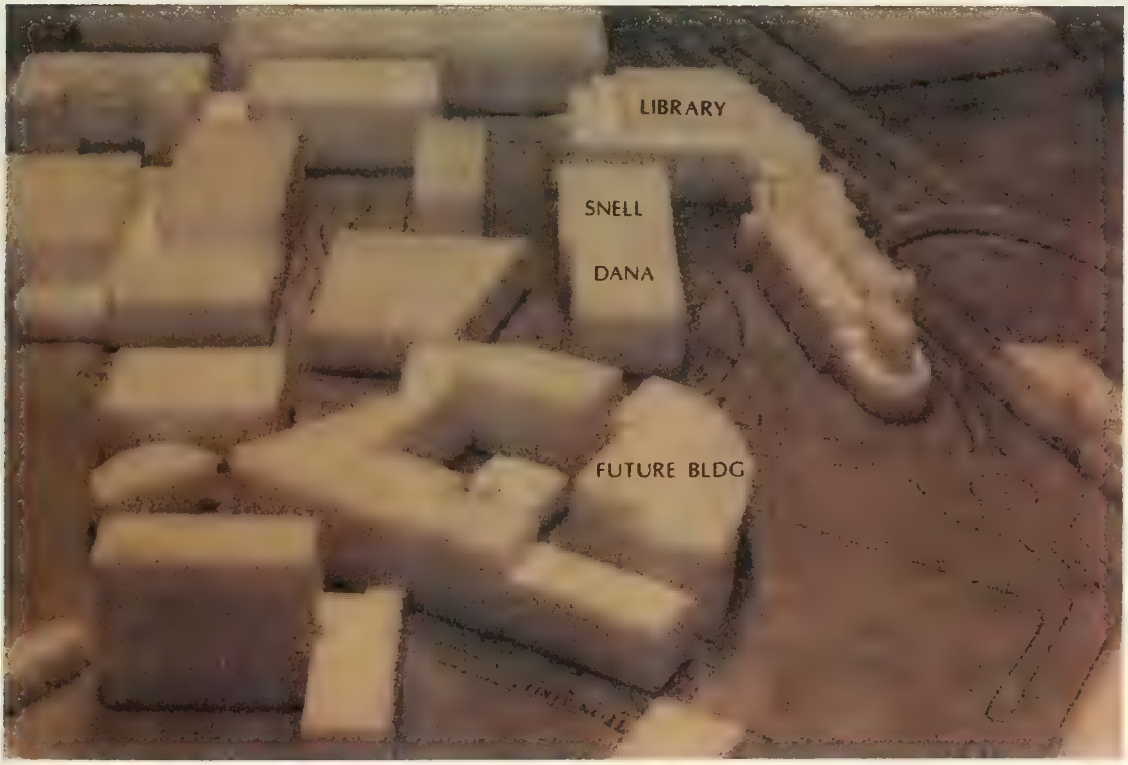
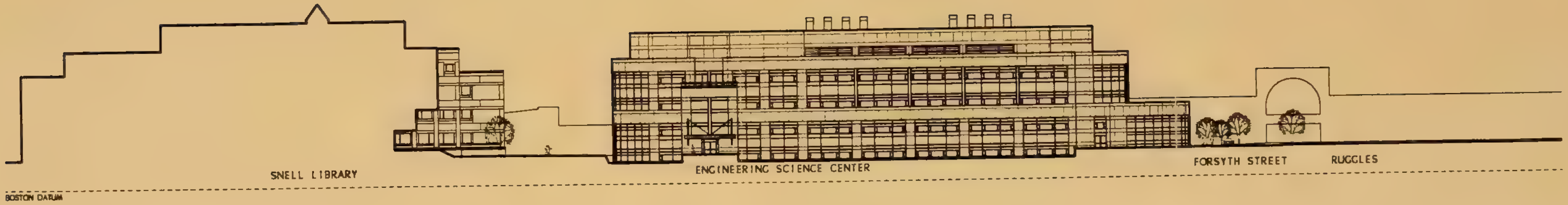

FUTURE BLDG
DANA
SNELL
LIBRARY
FORSYTH STREET
RUGGLES


LIBRARY
SNELL
DANA
FUTURE BLDG

g. Site Sections



NORTH/MALL ELEVATION

0 20 50 100 FT

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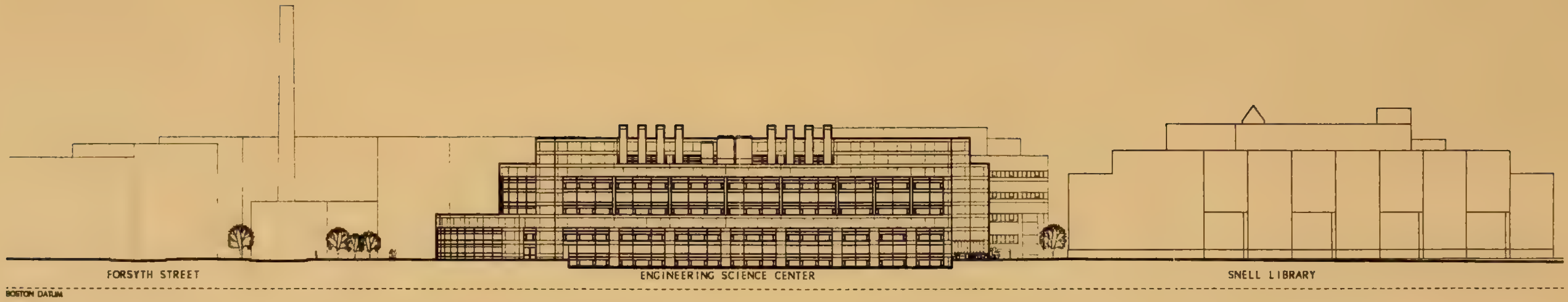

SOUTH/RUGGLES ELEVATION

0 20 50 100 FT

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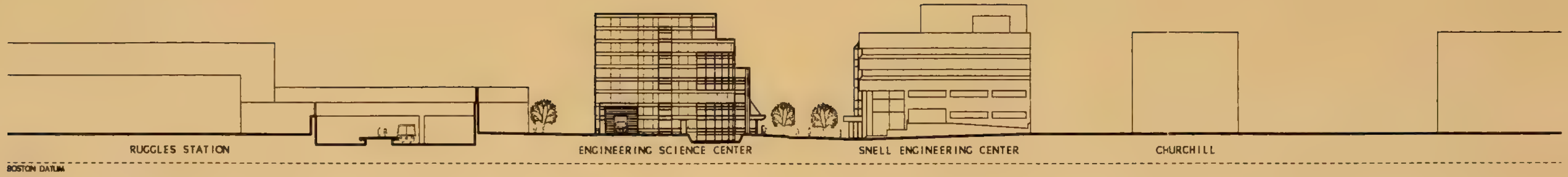

EAST/LIBRARY ELEVATION

0 20 50 100 FT

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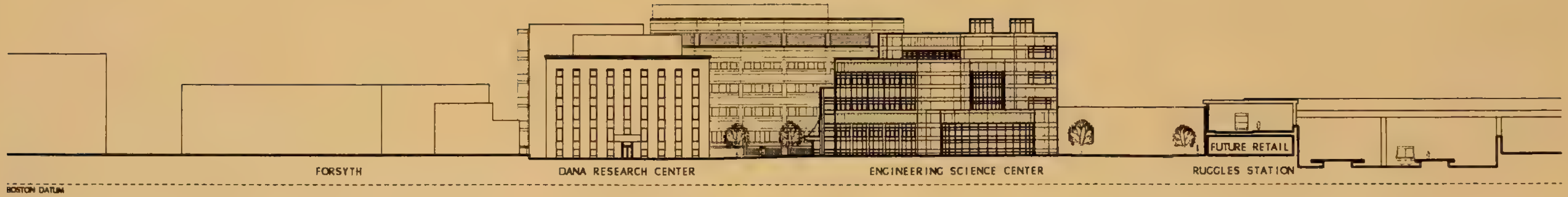

WEST/FORSYTH ELEVATION

0 20 50 100 FT

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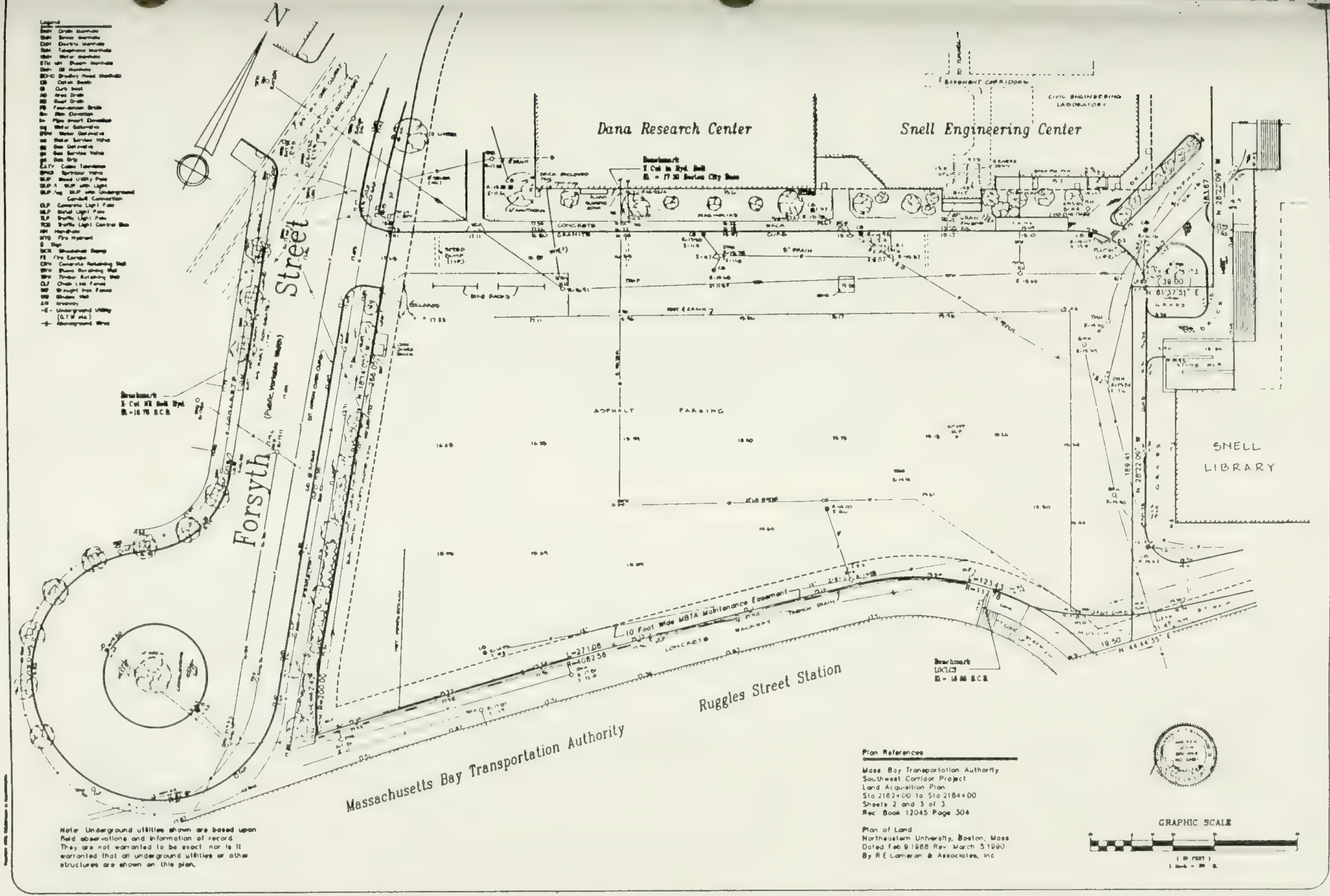
h. Site survey



Note: Underground utilities shown are based upon field observations and information of record. They are not warranted to be exact, nor is it warranted that all underground utilities or other structures are shown on this plan.

Plan References

Mass. Bay Transportation Authority
Southwest Corridor Project
Land Acquisition Plan
Sta 2182+00 to Sta 2184+00
Sheets 2 and 3 of 3
Rec. Book 12045 Page 304

Plan of Land
Northeastern University, Boston, Mass
Dated Feb 9 1988 Rev. March 5 1990
By R E Cameron & Associates, Inc

Topographic Plan
Northeastern University
Boston, Mass.

Scale 1"=20' | Drawn By AJB | Job 2018
Date July 20 1990 | Checked By RPH | Dwg 2018

R.E. Cameron & Associates, Inc.
681 WASHINGTON ST. – NORWOOD, MASSACHUSETTS 02062
CIVIL ENGINEERS & LAND SURVEYORS

NORTHEASTERN UNIVERSITY
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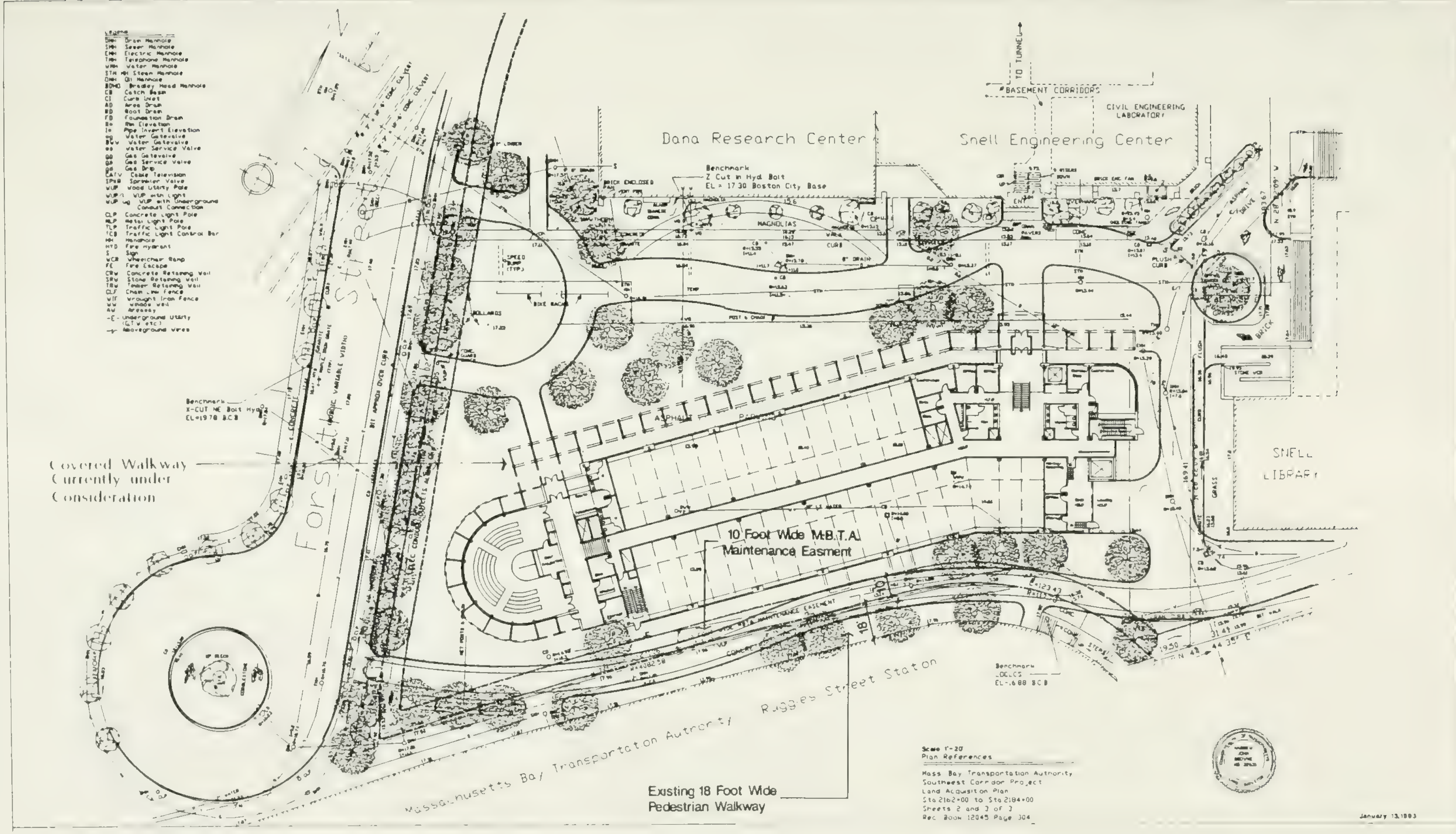
i. Site plans



Covered Walkway Currently under Consideration

10 Foot Wide M.B.T.A. Maintenance Easment

Existing 18 Foot Wide Pedestrian Walkway

Legend

DMH	Drain Manhole
SMH	Sewer Manhole
EMH	Electric Manhole
TMH	Telephone Manhole
WMH	Water Manhole
STM MH	Steam Manhole
OMH	Oil Manhole
BDMH	Bradley Head Manhole
CB	Catch Basin
CI	Curb Inlet
AD	Area Drain
RD	Roof Drain
FD	Foundation Drain
Re	Rim Elevation
Ie	Pipe Invert Elevation
wg	Water Gatevalve
BGV	Water Gatevalve
ws	Water Service Valve
gg	Gas Gatevalve
gs	Gas Service Valve
gd	Gas Drip
CATV	Cable Television
SPKB	Sprinkler Valve
WUP	Wood Utility Pole
WUP/L	WUP with Light
WUP ug	WUP with Underground Conduit Connection
CLP	Concrete Light Pole
MLP	Metal Light Pole
TLP	Traffic Light Pole
TCB	Traffic Light Control Bar
HH	Handhole
HYD	Fire Hydrant
S	Sign
WCR	Wheelchair Ramp
FE	Fire Escape
CRW	Concrete Retaining Wall
SRW	Stone Retaining Wall
TRW	Timber Retaining Wall
CLF	Chain Link Fence
WIF	Wrought Iron Fence
WW	Window Well
AW	Areaway
-E-	Underground Utility (E,T,W etc)
	Aboveground Wires

Scale 1"=20'
Plan References
Mass Bay Transportation Authority
Southwest Corridor Project
Land Acquisition Plan
Sta 2162+00 to Sta 2184+00
Sheets 2 and 3 of 3
Rec Book 12045 Page 304

January 13,1993

Proposed Treatment of M.B.T.A. Right of Way

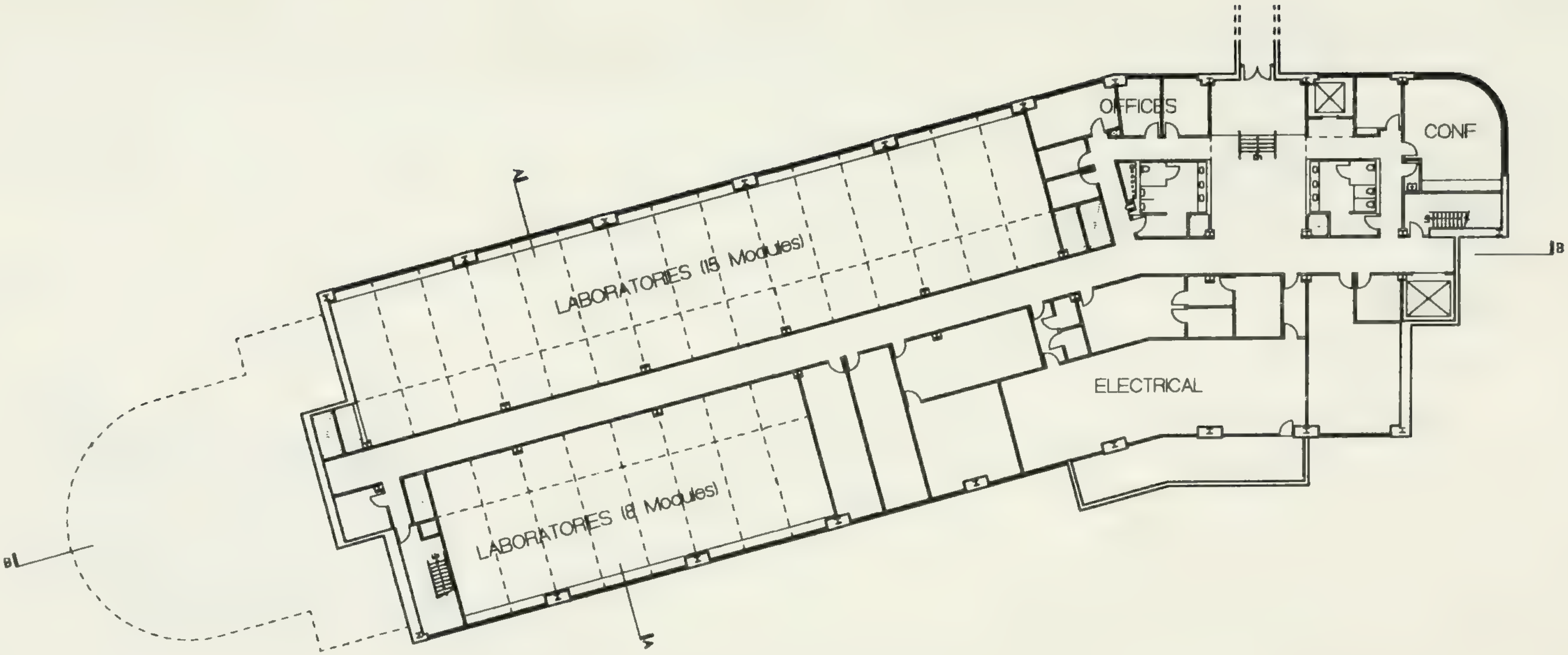
NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON
148 STATE STREET

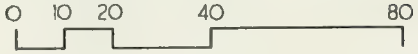
ARCHITECTS
BOSTON, MASSACHUSETTS

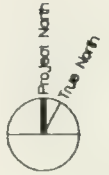
Pressley Associates, Inc
Landscape Architects

j. Building Plans



Lower Level Plan





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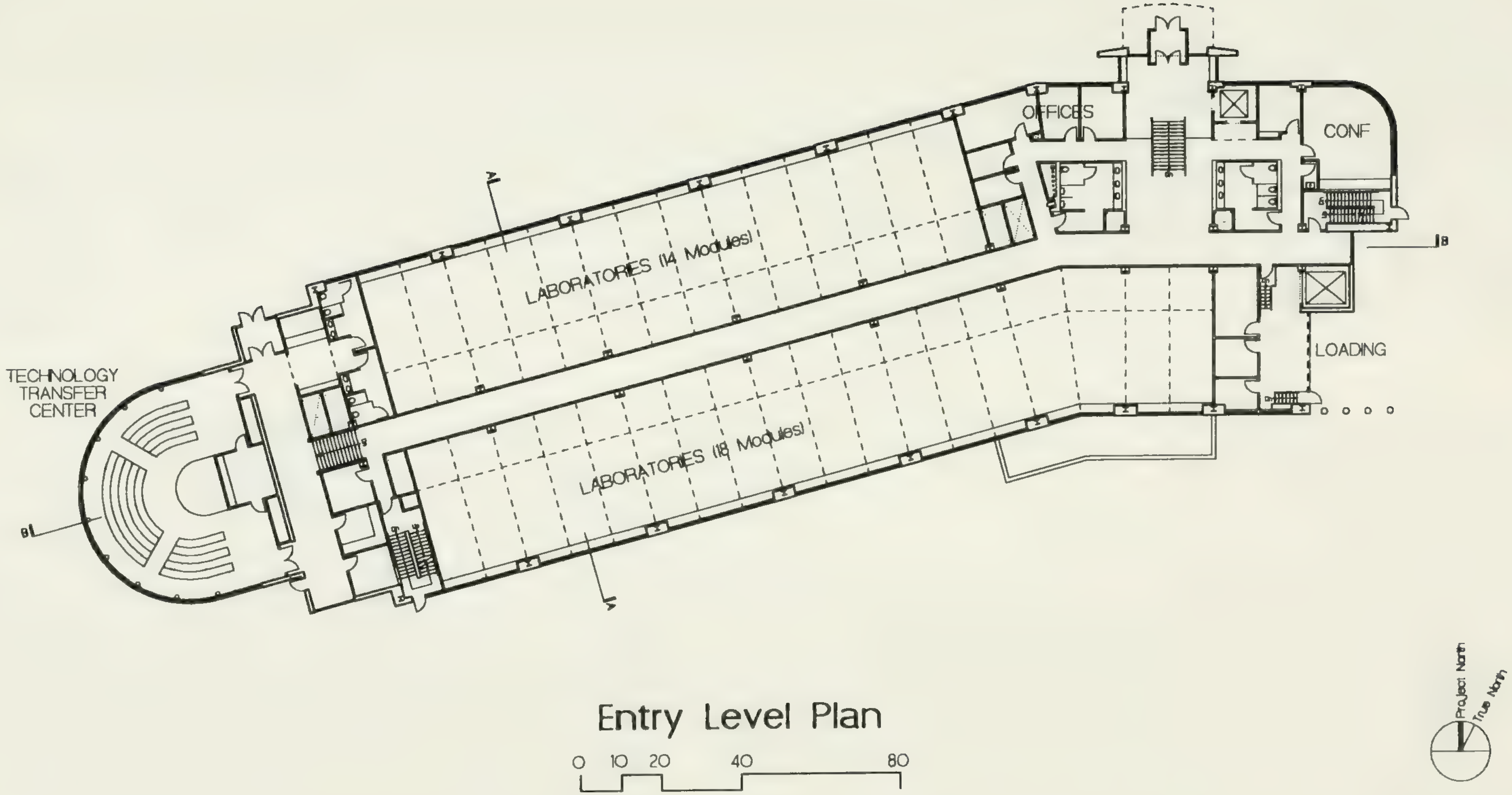
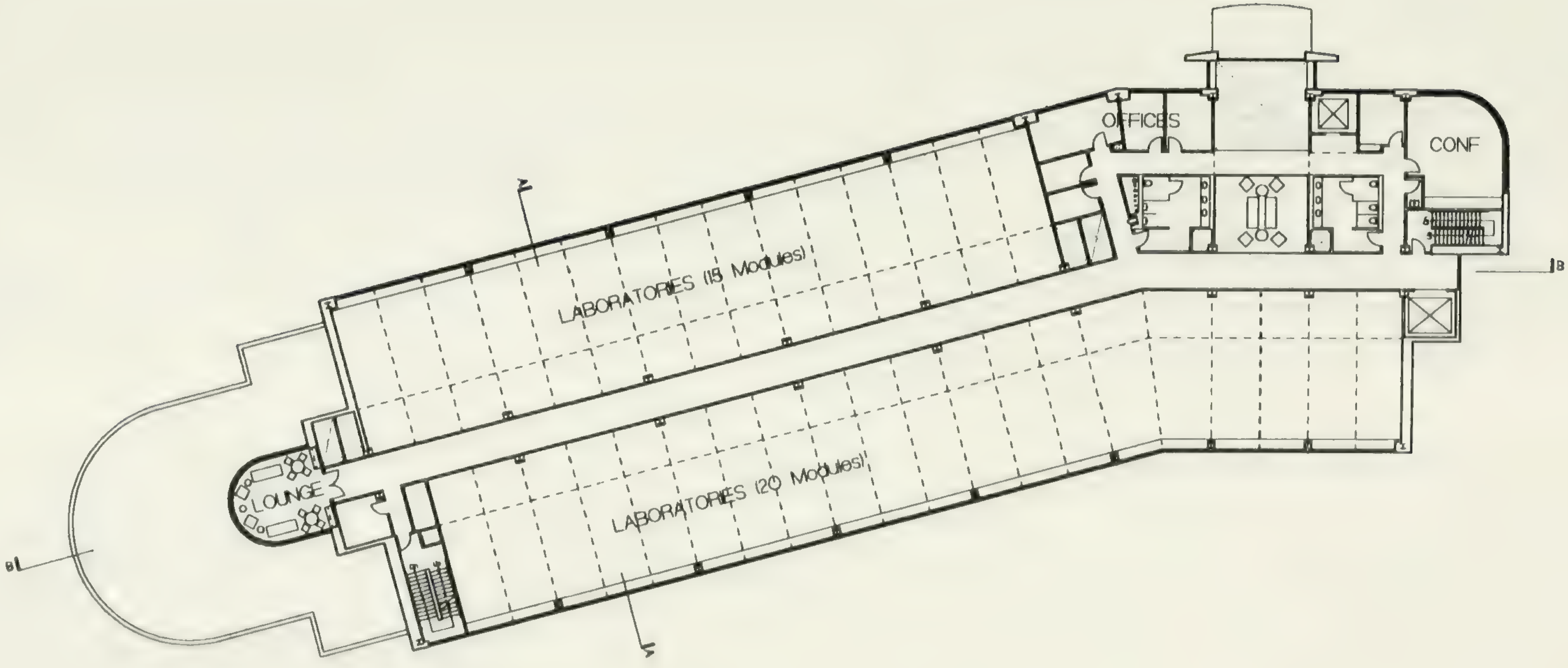


Entry Level Plan

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

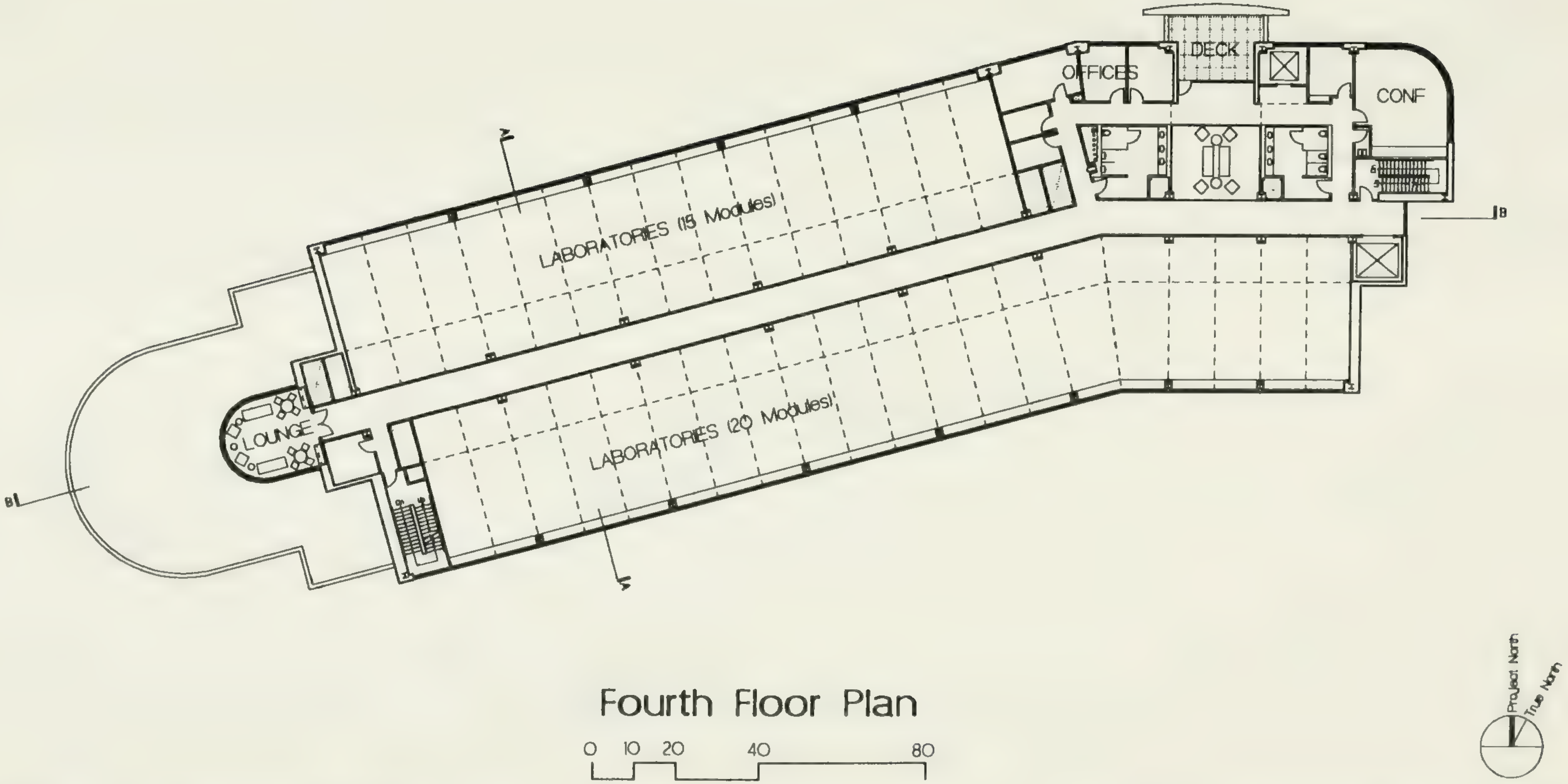
CANNON



Third Floor Plan

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON



Fourth Floor Plan

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

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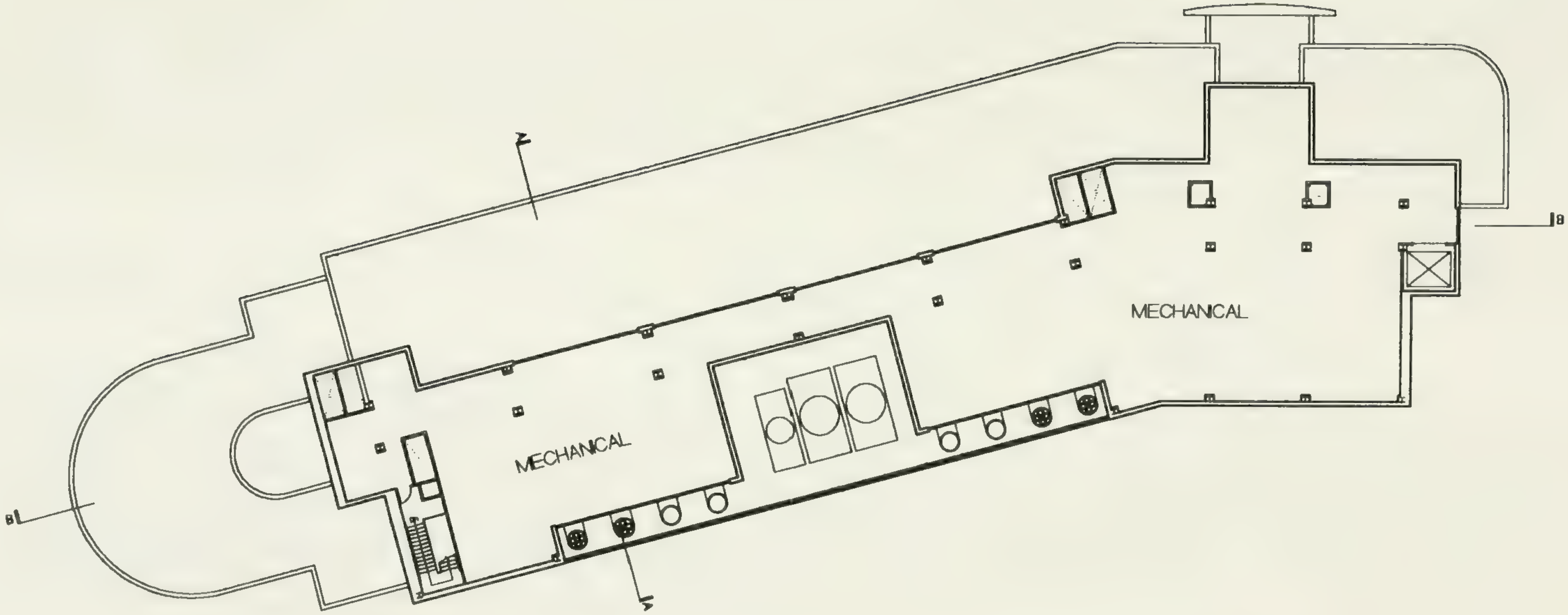
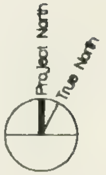


Penthouse Floor Plan

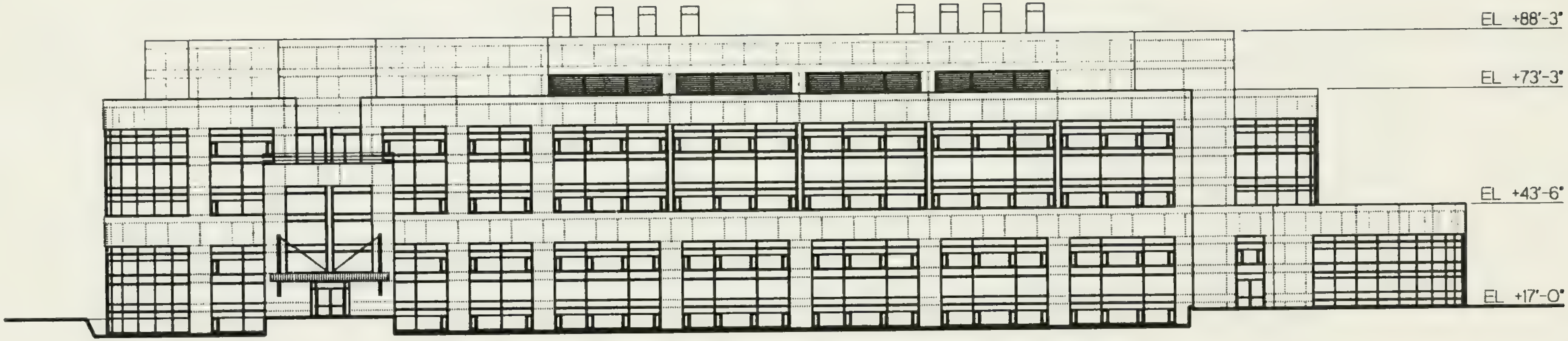


N O R T H E A S T E R N   U N I V E R S I T Y

ENGINEERING SCIENCE CENTER

CANNON

k. Building Elevations



North Elevation

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

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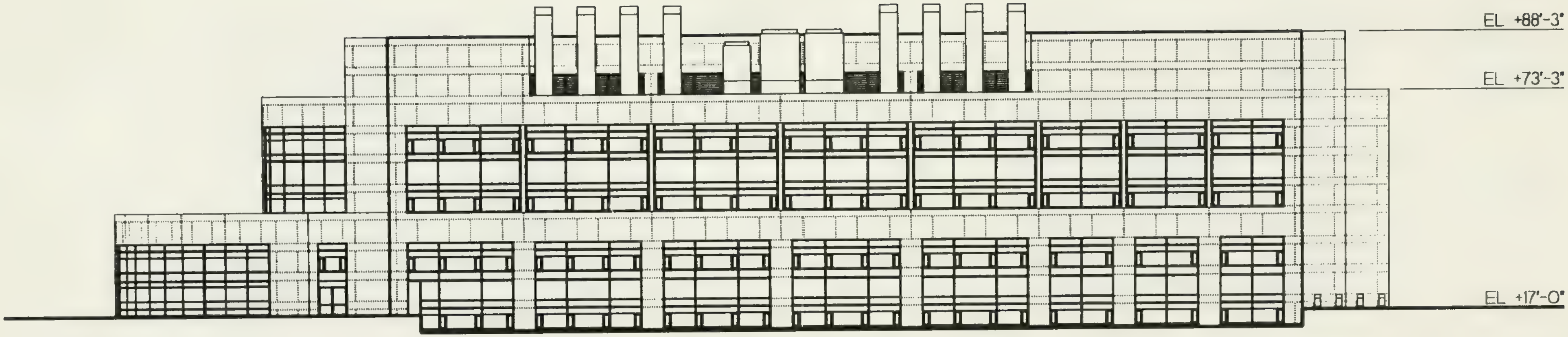
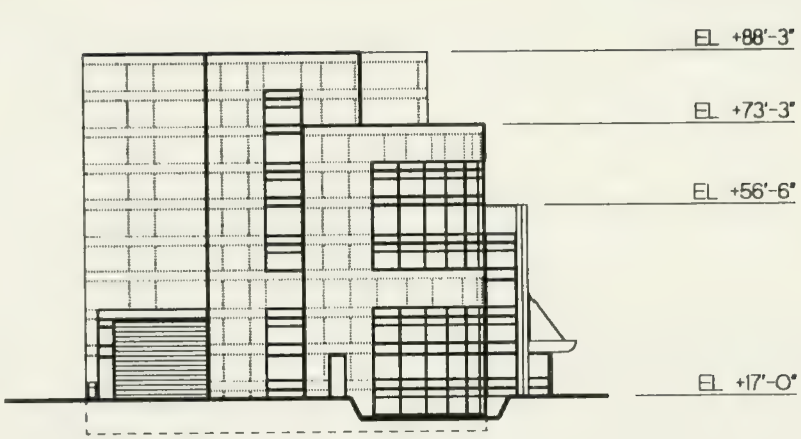


South Elevation

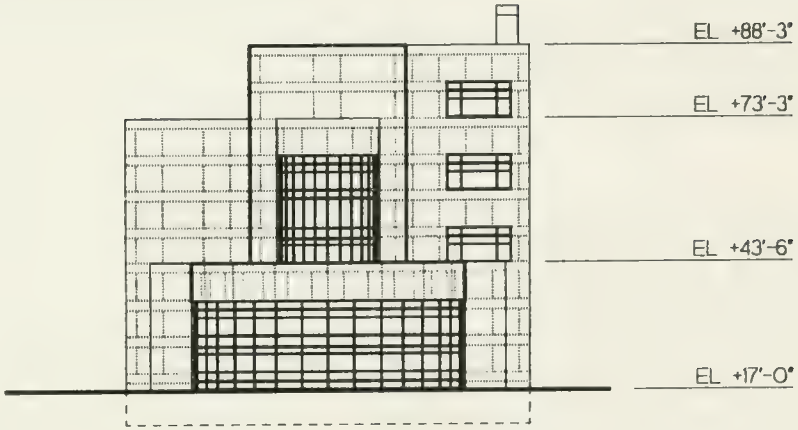
NORTHEASTERN UNIVERSITY

ENGINEERING SCIENCE CENTER

CANNON



East Elevation

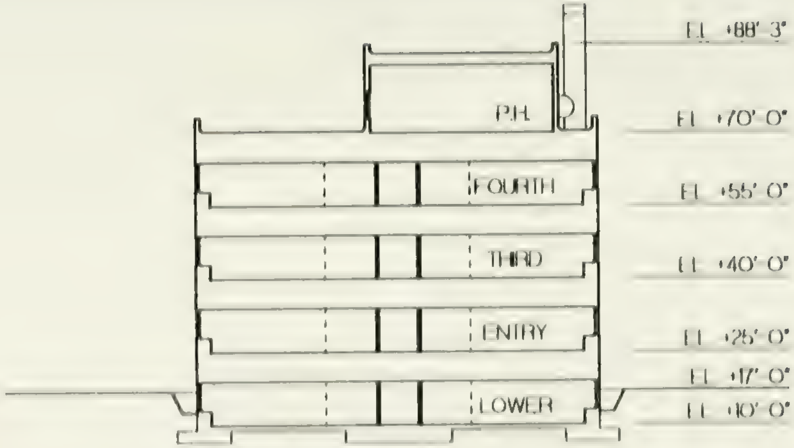


West Elevation

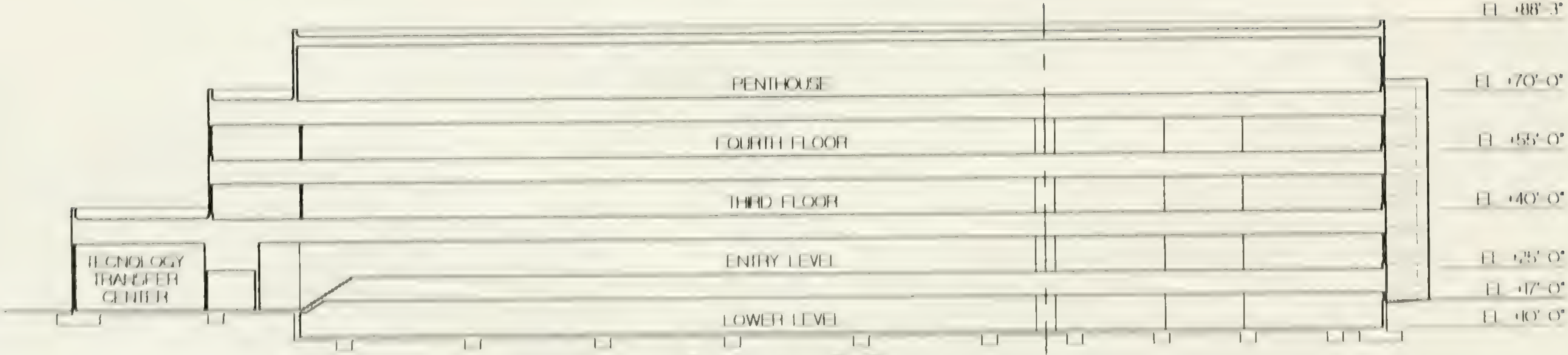
NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

I. Building Sections



Section A-A



Section B-B

NORTHEASTERN UNIVERSITY
ENGINEERING SCIENCE CENTER

CANNON

5. HISTORIC RESOURCES

5. HISTORIC RESOURCES

The Project site is currently occupied by a paved parking area. According to information available to Northeastern, the site was used as a railroad yard from the turn of the century until it was acquired by the University.

Based on a review of the State and National Registers of Historic Places as of January 15, 1993, there are no Register-listed historic properties on the Project site or in the immediate vicinity. The nearest property that is listed on the State Register of Historic Places is the New England Conservatory of Music (located at the corner of Huntington Avenue and Gainsborough Street) and the nearest historic district is the South End Historic District (located east of Camden Street). Attached is an area plan showing these and other historic properties in the area of Northeastern's campus. Based on the level of development in the area it is anticipated that the Engineering Science Center will not be visible from any historic structure. A copy of the Environmental Notification Form (ENF) for the Project was submitted to the Massachusetts Historical Commission, and no comments were received by the MEPA Unit of the Executive Office of Environmental Affairs from the Commission during the ENF 30-day comment period.

According to maps of archeological sites maintained by the Massachusetts Historical Commission, there are no known archeological sites located at or near the Project site. Based on the University's experience in past construction projects in the area, the presence of archeological resources which might be disturbed by the construction of the Project is not anticipated. To the University's best knowledge, significant archeological resources were not encountered in the construction of the Snell Learning Resource Center recently constructed on land adjacent to the Project site to the east, the construction of the Snell Engineering Center to the north, or the construction of the MBTA Ruggles Street station located adjacent to the Project site to the southwest. All of these projects involved excavations, including excavations to a depth greater than the foundation depth proposed for the Project.

HISTORIC PROPERTIES AND DISTRICTS NEAR NORTHEASTERN UNIVERSITY

The following is a list of the properties and districts located in the vicinity of Northeastern University's proposed Engineering Science Center which are listed in the State Register of Historic Places. The properties and districts are identified by number on the attached map.

1. Berger Factory, 37 Williams Street, Roxbury

2. Eustis Street Architectural Conservation District, Eliot Street Burying Ground, Roxbury*

3. Isabella Stewart Gardner Museum, 280 The Fenway

4. John Eliot Square Historic District, Roxbury (including Cox Building and First Church of Roxbury)

5. New England Conservatory of Music, 290 Huntington Avenue

6. Police Station #10, 1170 Columbus Avenue, Roxbury

7. Roxbury Highland Historic District*

8. St. Botolph Street Area*

9. South End Historic District*

10. Symphony Hall, Massachusetts and Huntington Avenues

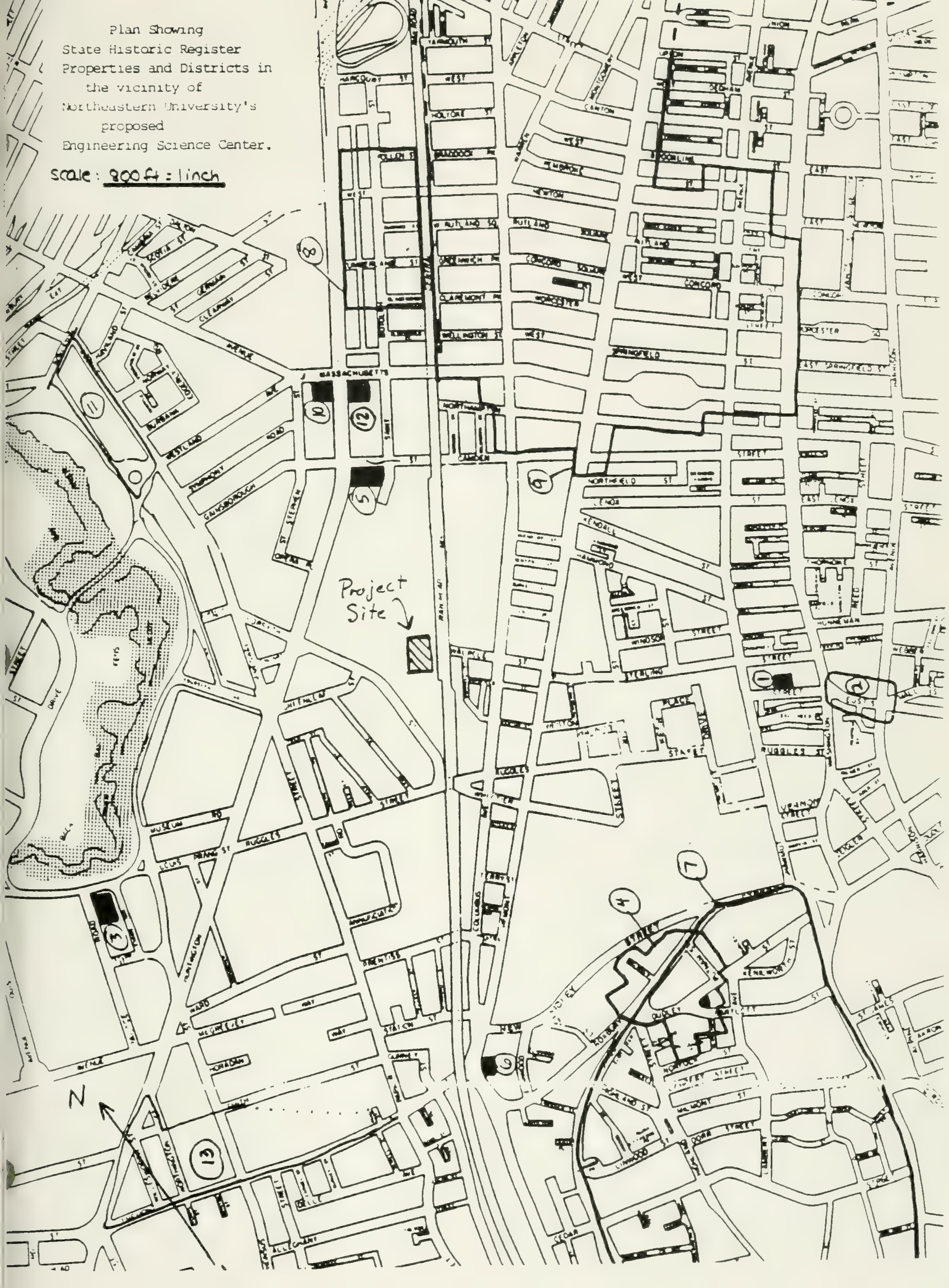
11. Fenway-Boylston Street Historic District* (the Fenway, Boylston, Westland and Hemenway Streets)

12. Horticultural Hall, 300 Massachusetts Avenue

13. Mission Hill Triangle* (Huntington, Tremont, Smith and Worthington Streets)

* Denotes approximate boundary shown on map

The Sears Building and the Mail Order Store located at 309 Park Drive and 201 Brookline Avenue are listed on the State Register; they are located just off the left side of the attached map. Also not shown on the map are the Museum of Fine Arts and the YMCA, both on Huntington Avenue, which have been recommended by the Boston Landmarks Commission for listing on the National and State Historic Registers. Certain other smaller properties along St. Stephens Street and St. Botolph Streets have also been reviewed by the Boston Landmarks Commission for historical significance.



Plan Showing
State Historic Register
Properties and Districts in
the vicinity of
Northeastern University's
proposed
Engineering Science Center.

scale: 800 ft = 1 inch

6. INFRASTRUCTURE

- a. Water And Sewer
- b. Energy Sytems

a. Water And Sewer

Vanasse Hangen Brustlin, Inc.

Engineers,
Planners,
and
Scientists

VHB

101 Walnut Street
P.O. Box 9151
Watertown, MA 02272
617 924 1770
FAX 617 924 2286

INFRASTRUCTURE SYSTEMS

1. Water & Sewer Systems

Water

Water service to the adjacent building (Dana Research Center (DRC)) is provided by an existing 10-inch diameter "low service" water main which is under the location of the new building. This line will be cut and connected to an existing 12-inch water main at Forsyth Street with a proposed 12-inch line. A new line to DRC and the services to the proposed building will connect to the proposed 12-inch line.

Based on hydrant tests in March 1992 and on consultation with BWSC, the existing 12-inch water main will have adequate pressure and capacity to service the proposed building even without the proposed looping. However, such "looping" will improve the existing water system around the site and allow service from two directions.

Since this new pipe is on University property, an easement will have to be granted to BWSC for future maintenance. If this is not feasible, the University will own and maintain the line and "master" meters will have to be installed at each property line crossing.

Sewer

The sewage effluent from the project will be directed to an existing manhole on site between the Dana Research Center and Forsyth Street. Flow from this structure discharges into a separate BWSC sanitary sewer on Forsyth Street.

Based on consultation with BWSC, the existing sewer system has adequate capacity for the project.

The BWSC sanitary system on Forsyth Street connects to a separate MWRA system on Huntington Avenue. This system ultimately drains through the Ward Street Headworks to the Deer Island Treatment Plant. According to BWSC, the sewer overflows "to the ocean" during high stormwater discharges.

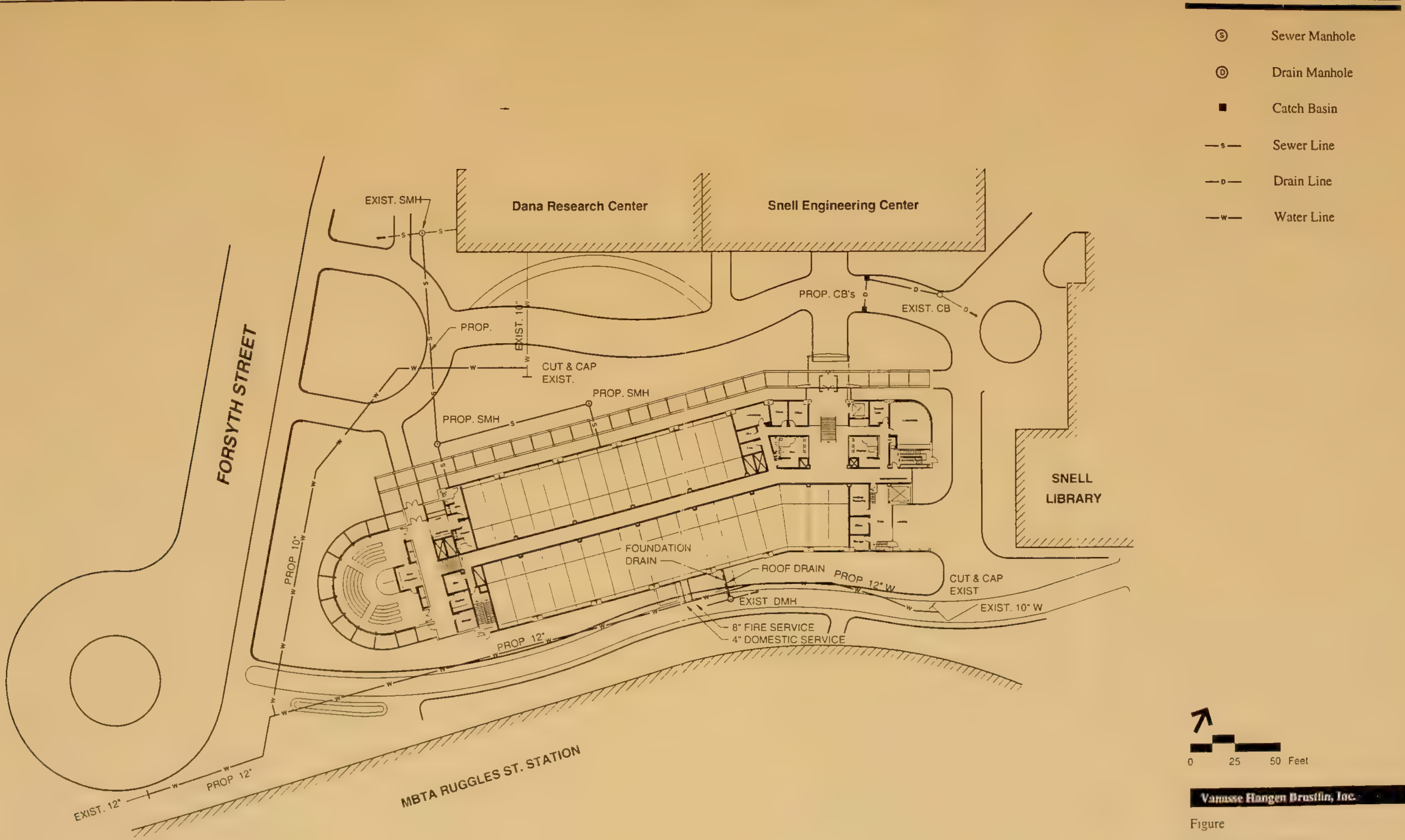
Secondly, any biological or chemical wastes will be pretreated or otherwise neutralized prior to discharge into the BWSC system. Therefore, the proposed project will not have any impacts on the water quality of the Charles River or other waterbodies.

Currently, the project site is almost entirely paved and used as a parking lot. The proposed project will replace the parking lot with landscaped areas, building roofs and pedestrian walkways. Therefore. stormwater runoff and associated pollutant levels will be decreased. Accordingly, water quality will be improved.

Sediment transport will be controlled during construction by temporary sediment traps around drainage inlets. These traps will be maintained throughout construction and will be removed after disturbed areas are stabilized.

The proposed building will contain a sprinkler system that will be serviced by the proposed 12-inch water main. The existing water system has adequate capacity and pressures to meet anticipated fire flow requirements.

The proposed sprinkler system will be designed according to the criteria set by the University's insurance company and will conform to all local, state and federal fire protection regulations.



Vanasse Hangen Brustlin, Inc.

Figure

Northeastern University
Engineering Science Center
Water, Sewer & Drainage Concept

3138DRAI.DWG

Cosentini Associates
Consulting Engineers

44 Brattle Street
Cambridge MA 02138

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S. A. Quart, PE

December 30, 1992

Cannon - Boston
148 State Street
Boston, MA 02109

RECEIVED
CANNON
MAR 3 1 1993
Proj. No. 881.00
File Category 4.0

Attention: Garrick Niemiec

Reference: Northeastern University
Engineering Science Center (ESC.)
Our Job No. 0258
Infrastructure Water and Sewer

Gentlemen:

Responding to information requested on the: Draft-Project Impact Report.

We provide the following comments:

I. Water and Sewage Consumption:

A. Sewage Load:
Building 95,000 ± Sq. Ft.
Based on 150 GPD/1000 Sq. Ft.
95,000 X 250/1000 = 23,750 GPD Peak

B. Domestic Water Load:
Based on 150% of Sewage Load
23,750 X 150 = 35,625 GPD Peak

C. Water Load for Cooling Tower Make Up

The cooling towers represent a total load of 100 tons and require water and sewer service as follows:

Consider water supply flow rate	3,000 GPM
Peak make up water required/day	30,000 GPD
Peak cooling tower evaporation	22,750 GPD
Peak cooling tower blowdown	6,750 GPD

II. Conservation for Plumbing and Fire Protection:

A.	Water Conservation	All plumbing fixtures installed at this project will be water conserving. (ie. water closets: wall hung, floor mounted will operate on a maximum of 1.6 gallons per flush; lavatories and sinks will be provided with 0.5 gallon per minute flow controls; urinals will operate on 1.0 gallon per flush; and showers will operate at 2.75 gallons per minute.
B.	Landscape Conservation	Wall hydrants on the periphery of the building will be used for watering the landscape in lieu of a lawn sprinkler system.
C.	Fire Protection Conservation	Venturi flow meter will be provided on the pump. This will be done to alleviate the waste of water (750GPM) for monthly testing.
D.	Steam	The steam condensate, from the steam provided to the project for Conservation heating of domestic and non-potable water systems as well as the building heating medium, will be collected and returned to the University plant for reuse.

III. Water supply including quantity and quality requirements:

A. Boston water to reverse osmosis system producing 1 megohm quality water through a pipe loop system throughout the building with final point-of-use-polishing units to provide pyrogen free water at benches. Rejected water from filters, including reverse osmosis water producing system, shall drainto storm system. All other rejected water after reverse osmosis system shall drain to lab waste system.

B. The fire protection service for the building will be piped from the existing campus water loop. A double check valve and a complete fire pump system will be required to service two combination wet standpipes. Standpipes located in stairwell to provide hose valves and sprinklers on each floor.

C. Storm Water/Sanitary Waste three independent systems are planned for this building. 1. Storm Drainage System (Roofs, Terraces, Plaza Drains), 2. Sanitary Drainage System (Water Closets, Urinals, Lavatories and Non Laboratory Sinks), 3. Laboratory Waste System (Lab Sinks and Lab Equipments) will be neutralized before discharging to the sanitary drainage system.

D. Electrical power for the building will be provided by Boston Edison. The electrical load is projected to be 2,000 KVA with annual power consumption estimated at 4,000,000 KWH. This includes lights, receptacle (appliance and equipment) loads, fans, chillers, elevators, pumps, etc. Boston Edison has confirmed that adequate power is available for this project.

E. Transformers for the building are located in the building and are accessed from the rear of the building (near the loading dock). The location is accessible to the fire department and electrical service trucks but is not in the path of pedestrian traffic.

Cordially,

Frank Teebagy, P.E.
Senior Associate

cc: Dick Leber
Bob Leber
Randy Duke

b. Energy Systems

Cosentini Associates
Consulting Engineers

44 Brattle Street
Cambridge MA 02138

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CANNON
MAR 31 1993
Proj. No. 881.00
File Category 4.0

December 30, 1992

Cannon - Boston
148 State Street
Boston, MA 02109

Attention: Garrick Niemiec

Reference: Northeastern University
Engineering Science Center (ESC.)
Our Job No. 0258
Infractructure Energy Systems

Gentlemen:

Responding to information requested on the: Draft-Project Impact Report.

We provide the following comments:

I. Anticipated Energy Requirements

A. Space heating for the ESC Project will be provided by the central University boiler plant. The ESC building is expected to need approximately 14,000 pounds of steam per hour at peak times. The University boiler plant will, upon completion of pending upgrading, be fired by both gas and oil as needed. Estimated fuel consumption for the ESC Project is no more than 20,000-22,500 MBTU per hour. In addition, laboratory steam will be required for autoclaves, glass and bottle washers and other typical laboratory uses. Peak use of laboratory steam is expected to be no more than 2,000 pounds per hour.

B. The project is currently evaluating 2 alternative schemes for energy conservation on air systems in the building. The first scheme being considered is a two position (occupied/ unoccupied) system which will reduce the supply air volume and the exhaust air volume by approximately 50% when the area is not in use. The second scheme is a fully variable volume fume hood sash position tracking system which will continuously adjust the supply air volume and the exhaust air volume based on the air quantity required to satisfy the fume hood condition. Each of these schemes will reduce the total air volume supplied to the lab over the year reducing energy consumption for both the electric cooling (via centrifugal refrigeration machines) and steam heating of the make-up air.

C. Space heating for the ESC Project will be provided by the central University boiler plant. The ESC building is expected to need approximately 14,000 pounds of steam per hour at peak times. The University boiler plant will upon completion of pending upgrading, be fired by both gas and oil as needed. Estimated fuel consumption for the ESC Project is no more than 20,000-22,500 MBTU per hour. In addition, laboratory steam will be required for autoclaves, glass and bottle washers and other typical laboratory uses. Peak use of laboratory steam is expected to be no more than 2,000 pounds per hour.

D. Emergency power will be provided by a diesel generator set. The generator will supply life safety loads (egress lighting, fire alarm system, etc.), fume hood exhaust fans, and limited laboratory equipment (environmental chambers, freezers, and selected equipment).

E. Transformers for the building are located in the building and are accessed from the rear of the building (near the loading dock). The location is accessible to the fire department and electrical service trucks but is not in the path of pedestrian traffic.

Cordially,

Frank Teebagy, P.E.
Senior Associate

cc: Dick Leber
Bob Leber
Randy Duke

BOSTON EDISON
800 Boylston Street
Boston, Massachusetts 02199

December 30, 1992

Mr. Randy Duke
Cosentini Associates
44 Brattle Street
Cambridge, MA 02138

Re: **Northeastern University**
New Engineering & Science Building

Dear Mr. Duke:

Referencing the above project and the request for up to 2,000 kW of new electric demand, Boston Edison has adequate capacity to supply this need. Please provide the electric demand breakdown, expected completion date and the earliest date you will need this power to Robert T. Woodman. Bob can be reached at 424-2324.

Very truly yours,

Mort McGrath
Manager
Major Customer Division

MM/mma

cc: R. T. Woodman

MM92340

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